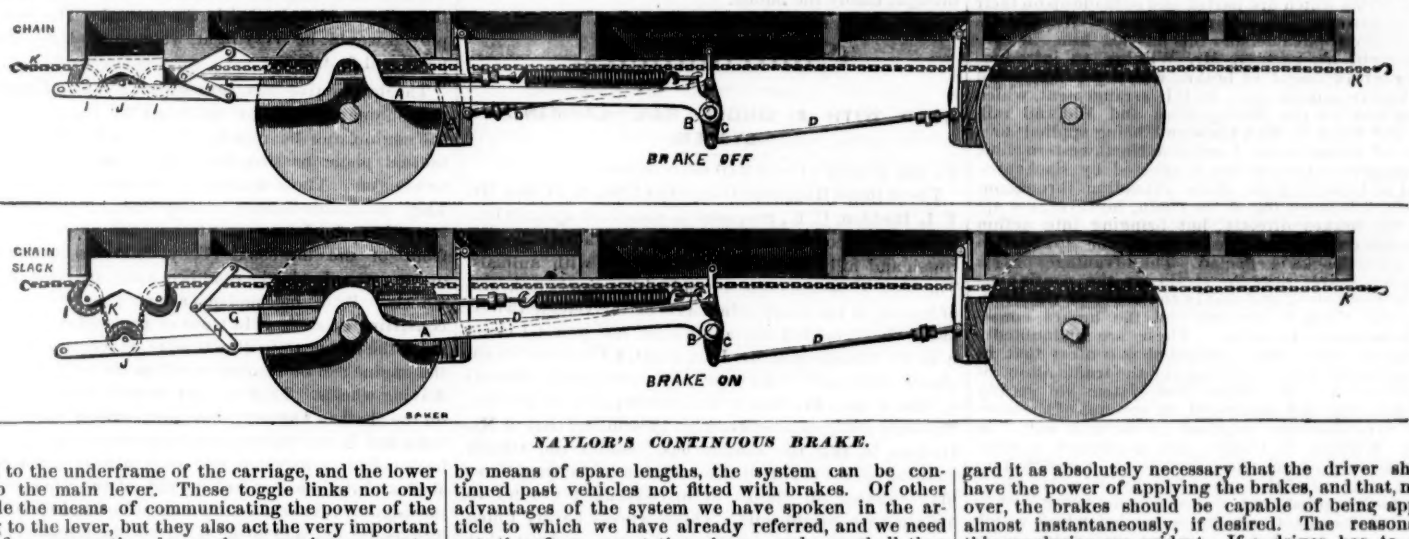
RAILROAD GAZETTE

SATURDAY, APRIL 29, 1871.

NAYLOR'S CONTINUOUS BRAKE.

We copy from *Engineering* the following description of a recent English invention, together with an editorial from the same journal on the general subject of continuous brakes:

In an article on "Continuous Brakes," published on another page of the present number, we have referred to an arrangement of brake recently brought out by Mr. William Naylor, and one form of this brake we illustrate on the present page. Mr. Naylor's continuous brake may be described as essentially an adaptation of the ordinary lever wagon-brake to the purposes of working sets of brakes on a train of carriages. It consists, as shown in our engravings, of a main lever, *A*, keyed on to a weigh shaft, *B*, immediately under the center of each carriage, this lever corresponding to the ordinary brake lever applied to wagons. The short double-ended levers *C C*, also keyed on to the weigh shaft, are connected to the brake block push rods, *D D*; these again being connected at their other ends by the blocks, *E E*. The power required to force the blocks against the wheels is provided by means of a spiral spring, *F*, one end of this spring being attached to a lug on the main lever, and the other being coupled to a tension rod, *G*, attached to the center joint of the toggle links, *H H*. The top joint of these toggles is attached to a bracket



NAYLOR'S CONTINUOUS BRAKE.

bolted to the underframe of the carriage, and the lower end to the main lever. These toggle links not only provide the means of communicating the power of the spring to the lever, but they also act the very important part of compensation levers by assuming a greater angle as the spring loses its tension by the descent of the main lever; practically, therefore, there is always the same amount of force acting on the brake block push rod levers, no matter at what angle the main lever may happen to be. The spring is only (by preference) made of sufficient power to barely skip the wheels under the worst conditions of weather, and as there will be a large reserve of power by the brakes being applied to all the carriages, a considerable saving will be effected in the wear of tires alone. Spiral springs, such as Mr. Naylor employs, have been in use for years on "oliver" hammers, and in other situations where they have to withstand rough usage, and there can be no doubt that they will be found reliable in the arrangement we illustrate.

To remove the brake from the wheels, two pulleys, *I I*, are attached to the carriage frame, and one, *J*, to the main lever, a continuous chain, *K K*, passing over the two first and under the one attached to the lever. It will easily be seen, therefore, that the chain being fast at one end of the train, and hauled taut at the other, the lever, *A*, under each carriage will be successively lifted and the brakes removed. The converse of this operation enables the brakes to be applied either almost instantaneously or as slowly as may be desired. We may liken the operation to a series of weights being lowered by means of a winch from a high warehouse; these may be lowered quickly or slowly, according as the brake on the winch is released entirely or partially.

For tightening the chain, Mr. Naylor has devised several arrangements, each applicable under certain circumstances. In cases where the brake is applied to wagons, an arrangement is provided for tightening the chain by hand, and holding it taut by a brake applied to the winding drum, these brakes being so arranged that they can be easily released by a man as a train of wagons passes him. We intend shortly to illustrate this arrangement of wagon-brake, and we shall therefore say no more about it here. When his system of brakes is applied to a train, and is intended to be worked solely by the guards, Mr. Naylor either fits to one of the guard's vans an arrangement of winding gear, which enables the guard to tighten the chain by hand; or, if the train is one making frequent stops, he places a pinion on the axis of the winding drum, and imparts motion to his pinion by a rack attached to the rod of a piston moving in a cylinder to which compressed air can be admitted. The supply of compressed air for actuating this arrangement is supplied from a reservoir, which is kept filled by a pump, this pump being worked by an eccentric, which is driven by frictional contact with one of the axles of the guard's van. The reservoir is fitted with a simple form of regulator, which, when the pressure reaches the desired amount, stops the working of the pump by throwing the eccentric out of action.

In the case of a train now being fitted with Mr. Naylor's brake on the London, Chatham & Dover Railway, another mode of tightening the chain is adopted. In this instance the brake is to be worked by either the driver or guard, and the apparatus for tightening the chain is to be fixed on the engine. It consists merely of an arangement similar to one of Armstrong's hydraulic cranes, the hydraulic cylinder, however, being replaced by a steam cylinder, which, by means of a reducing valve, is to be supplied from the boiler with steam of 60 lbs. pressure. We hope in a future number, when giving an account of the trials of this brake, to illustrate and describe this arrangement fully.

Whatever arrangement is employed for hauling in the chain, the latter, when tightened, is held simply by a brake on the winding drum, and by releasing this brake gradually or suddenly, the brake on the carriages is applied as gradually or as promptly as is required. The play of the buffers is allowed for and the chain maintained at a uniform tension by connecting one end of it to a straining lever actuated by a spring. It will be seen, from the particulars we have already given, that the brake is always maintained in a state fit for instant application, a very important feature in the case of brakes applied to fast trains. The working parts, too, are but few, and are of a simple kind, and even the entire failure of the lever arrangements on one carriage would not affect the application of the brake to the remaining vehicles of the train. The arrangement also gives facilities for attaching or detaching carriages, each carriage being provided with its own length of chain, while, by means of spare lengths, the system can be continued past vehicles not fitted with brakes. Of other advantages of the system we have spoken in the article to which we have already referred, and we need not, therefore, repeat them here; and we shall thus merely mention, in conclusion, that Mr. Naylor's brake is being introduced by Messrs. Budd & Holt, of 7 Great Winchester street buildings, E. C., at whose offices we recently examined some large-sized models of the arrangement, which illustrate its action very clearly.

The editorial in *Engineering* referred to at the beginning of this article, under the head of "Continuous Brakes," is as follows:

We have repeatedly urged in this journal the necessity of supplying to fast trains a far greater amount of brake power than that with which they are usually provided, and we are glad to find that the question of how this requisite increase of brake power can be best obtained is now strongly attracting the attention of our leading railway companies. Although we consider that railway authorities are, to a certain extent, to blame for not having already given to this subject so great an amount of attention as it deserves, yet we must acknowledge that the production of an arrangement of continuous brake which shall accommodate itself to all the requirements of general traffic, is by no means an easy task. Scores of brakes have been devised and patented within the last twenty years or so—in fact, locomotive and carriage superintendents have been pestered with the schemes of sanguine inventors of such contrivances—but probably not one-twentieth of which do possess any merit whatever, while of those these plans possess a certain amount of promise, but a fractional part would stand the rough test of practical working. Even of the few continuous brakes which have been brought into actual and regular use, we find but a small proportion which are adapted for application to trains run at a high speed, and accommodating traffic which necessitates the attachment or detachment of vehicles at intermediate stations; and, hence, as we have said, there is some excuse for the delay which has taken place in the general adoption of continuous brakes by railway companies.

The requirements which a continuous brake, applied to fast trains, should fulfil, may, we think, be summarized as follows: 1. That the brakes shall be applicable with equal facility by either guard or driver; 2. That the act of applying the brakes shall require but very slight exertion on the part of the man performing it; 3. That the application of the brakes shall be capable of being performed either almost instantaneously, if necessary, or gradually; 4. That if a part of the train should break away, the brakes should come at once into action; 5. That the system should admit of carriages (whether fitted with the brake arrangement or not) being attached or detached, or "slipped" from the train; 6. That when a train is divided, the brakes on each division should be capable of being worked independently; 7. That the failure of the brake apparatus on one or more carriages should not interfere with the action of the brake on the rest of the train; and 8. That the mechanism of the brake should be of very simple character, easy to maintain, and not liable to become deranged by the rough usage to which brakes are necessarily exposed, or by the partial neglect which is more or less certain to be the fate of some detached vehicles, in the event of a system of continuous brakes being extensively applied. These requirements are somewhat numerous, but they are all actual necessities, and it is absolutely certain that no brake which does not satisfy the whole of them more or less perfectly will successfully stand the test of experience on an extensive scale.

In the case of trains working what is now generally called local traffic, the necessity that a brake should fulfil the 4th, 5th and 6th requirements above mentioned ceases to exist, although it is still convenient that it should possess these qualifications. Neither is it absolutely necessary in such instances that the brake should be capable of being worked by the engine driver, as on local trains the guards have generally but little luggage to look after, and are consequently able to fulfil the duties of brakesman more perfectly. Although, however, the absolute necessity for such an arrangement does not exist in the case of local trains, we nevertheless consider it extremely desirable that in trains of *every* class the engine driver should have the power of applying the brakes in case of emergency, and in a far greater majority of instances the tasks of applying the brakes, even when approaching stations in the course of ordinary working, should be performed by the driver or his fireman.

We have said that in the case of the fast trains, we regard it as absolutely necessary that the driver should have the power of applying the brakes, and that, moreover, the brakes should be capable of being applied almost instantaneously, if desired. The reasons for this conclusion are evident. If a driver has to communicate to the guard the fact that it is necessary to apply the brakes, the time lost before the brakes are actually applied will, even if the guard act with all reasonable promptness, really exceed that necessary to stop the train after the application of the brakes has been made—the use of continuous brakes being, of course, supposed. Thus, in the case of a train moving at the rate of 60 miles per hour, the application of a total retarding force (made up of brake friction, atmospheric resistance, etc.) equal to one-fifth of the weight of the train will suffice to bring the latter to a stand in a run of 602 feet, and this distance will be run by the train with a decreasing speed in a little less than 14 seconds. But in how many cases will a guard, when unexpectedly called upon to do so by the driver's whistle, manage to get his brake properly applied in 14 seconds? Not, we venture to say, in one case out of a dozen. Theoretically, a guard should instantly apply his brake upon hearing the driver whistle for him to do so; practically, he but too often looks out to see what the driver is whistling about, and applies his brake afterwards. Many valuable seconds are lost in this way, and in the case of a train rushing along towards an obstacle in front at the rate of 60 miles per hour, or 88 feet per second, these few seconds may make all the difference between perfect safety and absolute destruction.

The same reasons which we advanced for placing the control of the brakes in the hands of the driver—the man who is almost always the first to see danger, and the best qualified to act on any emergency—also prove the necessity of the second and third requirements we have mentioned. If the application of a system of brakes requires much exertion on the part of the man making the application, it is certain not merely that time will be lost, but that there will arise, in some instances, a disposition on the part of the men to shirk that exertion, and that consequently delays will sometimes occur in bringing the brake into action which may be attended with disastrous consequences. This consideration brings us to the question of how the power required for applying the brakes can be best obtained? One thing is certain, that in a system of continuous brakes the mere manual power of a guard or fireman cannot be relied upon for producing the necessary promptness of action, and some other source of power is therefore necessary. In Creamer's brake, which has been much used in America, and which was tried here on the Southeastern Railway some years ago, this power is given by a coiled spring of hard brass, this spring being liberated when the brakes have to be applied. In the case of a

series of brakes having to be worked throughout a train, this plan of storing up the power in large springs is open to objections, and there are other points about the Creamer system which renders it more applicable to American rolling stock than to that used on English lines. In Kendall's brake, tested some two years or so ago, on the London, Chatham & Dover Railway, and described by us at the time, a store of compressed air contained in a suitable receiver was employed as the requisite reservoir of power, the supply of air being kept up by by a pump worked from one of the axles of the guard's van. This brake acted with great promptness, and was applied simply by opening a cock, and so far it fulfilled the second and third requirements we have mentioned admirably; but it was not well adapted for use on trains to or from which carriages had to be attached or detached, and it was, moreover, liable to be disabled by leakage, so that probably the fact of our having heard nothing of it for some time is accounted for. In Clark's original brake, as also in Loughridge's brake, introduced many years ago in the United States, the power required for applying the brake blocks is obtained by utilizing the momentum of the train itself, one or more pairs of friction pulleys being pressed against the wheels of the guard's van, and motion being thus communicated to the drum on which a chain extending through the train is wound, the strain on this chain applying to brake blocks. This system has been worked with much success for some years past on the North London Railway, and where the trains are made up to a constant number of carriages, as is the case on the line just mentioned, the arrangement is undoubtedly an excellent one. On the North London Railway each train may be considered almost as a single composite vehicle, and each is subject to regular periodical inspection as a whole, the conditions being thus especially favorable to the employment of a system of continuous brakes. In the case of trains which are parted and re-made up on their journey, however, this original system of Mr. Clark's is less easily applicable, and this has led him, in conjunction with his partner, Mr. Wilkins, to introduce another arrangement of brake, which we illustrated about twelve months ago. In this arrangement, which is being tried on the Metropolitan and Midland railways, and which is, we understand, being applied to a number of trains on the London & Northwestern line, the application of the brakes is effected by slackening instead of tightening the chain extending throughout the train, this loosening of the chain, however, not applying the brakes directly, but bringing into action mechanism on each carriage by which the application of the brake blocks is effected. The advantages of this arrangement are, that the strain on the continuous chain is diminished, and that in the event of the train parting this chain is broken, and the brakes consequently brought into action. These are undoubtedly advantages; but we must nevertheless confess that in all cases in which the conditions of the traffic allow of the application of Mr. Clark's first system we greatly prefer it to that last mentioned, on account of the more simple arrangements required to carry it out. In Messrs. Wilkins & Clark's last mentioned system, the slackening of the chain brings an eccentric into contact with one of the axles of each carriage to which the brake is applied, and this eccentric, being driven by frictional contact, actuates a ratchet wheel which communicates its motion to a winding drum, upon which is thus wound a chain which effects the application of the brakes. The amount of strain put upon this chain is governed by friction clutches which connect the ratchet wheel with the winding drum.

We do not propose here to deal with the question of the maintenance of these various details just mentioned—our practical readers are fully capable of doing that for themselves—but we desire to direct attention to a feature common to Messrs. Wilkins & Clark's brakes, and all others of their class. This feature consists in the fact that whenever the plan of actuating the brakes from the wheels or axles of a train is adopted, it is necessary that the train should run a certain distance after the brake apparatus is put in action before the brake is fully applied. So long as the play between the brake blocks and wheels, when the brake is off, remains constant, this distance is fixed, and is quite independent of the speed at which the train is traveling, while the greater the play allowed between the brake blocks and wheels, the greater the distance becomes. This feature is objectionable when great promptness of action is required, notwithstanding that the *time* occupied in bringing such a brake into operation decreases as the speed at which the train is running increases.

We have, so far, only spoken in this article of brakes which have been actually tested, but we feel bound, before concluding, to refer to an arrangement of continuous brake which, although not actually in use as yet, is just about to be applied on the London, Chatham & Dover Railway, and which appears to us to be a very promising one. The system of brake to which we refer, is that of Mr. William Naylor, and as we illustrate one mode of applying it on another page of the present number, we need describe its peculiarities but briefly here. According to the plans to be adopted on the London, Chatham & Dover Railway, Mr. Naylor fits each brake carriage with a long brake lever fixed on the weigh shaft which carries the arms by which the brake blocks are applied. This long lever is, when the brake is out of action, held up by a chain, which passes under a pulley at its extremity, this chain extending throughout the train, and being kept taut by suitable appliances. On this chain being slackened, the long lever falls, partly on account of its own weight and partly because it is pressed down by the action of a spiral spring. In the employment of a long lever held up by a chain in this way, Mr. Naylor's plans bear some resemblance to an arrangement proposed some time ago by Mr. William Bridges Adams, but unlike Mr. Adams, Mr. Naylor does not trust to the weight of the lever, but insures a greater promptness of action by the employment of the spiral springs we have mentioned. Moveover, by the aid of a simple arrangement of toggle joint, the diminished pull exerted by the spring as its tension decreases is compensated for, and an almost uniform strain is put upon the brake blocks.

The chain which holds up the levers can be released with great promptness by simply slackening a brake applied to the drum on which it is wound, and this being done the brakes go on throughout the train one after the other as fast as the chain can run out, and under the influence of the springs this is very fast indeed. This action is clearly shown by some excellent large-sized models which Mr. Naylor has had constructed, and which we may mention are now on view at the offices of Messrs. Budd & Holt, 7, Great Winchester street buildings. Of course, in the event of the train parting, the brake chain is broken, and the brakes brought at once into action, so that if the breaking away occurs on an incline, the brake will be applied before the hind part of the train has time even to commence running back. In this respect Mr. Naylor's arrangement possesses a decided advantage over those in which it is necessary that the train should run a certain distance before the brake blocks are applied. For tightening the chain, and thus taking off the brake, Mr. Naylor employs several arrangements, according to circumstances, and, as we have described the chief of these arrangements in our account of the brake on another page of the present number, we need not enter into particulars of them here. The brake, which is being applied to a train on the London, Chatham & Dover Railway, will be capable of being worked by either the driver or guard, and we shall look forward to its trial—of which we hope, in due course, to lay full particulars before our readers—with some interest. That these trials will be successful we have little doubt, and we, in fact, look upon Mr. Naylor's as one of the most promising arrangements of continuous brakes for main-line trains and fast traffic which has yet been brought before the public.

Contributions.

ROAD WITH A SINGLE RAIL—LARMANJAT'S SYSTEM.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I read in the RAILROAD GAZETTE of March 25, that Mr. T. L. Hadden, C. E., proposes to construct a single-line tramway for conveyance of goods and minerals through rough and hilly districts, to be worked with animals. The idea of establishing a road with a single rail, and of having in the longitudinal axis of the vehicle two or more wheels behind one another, is not new. I claim it as the invention of Mr. Larmanjat, a French civil engineer, who has for two years past established railroads of that system in France and other parts of Europe. The only difference between his system and that of Mr. Hadden is, that the vehicle has, besides the wheels running on the rail, two other wheels in the transverse plan running on planks or macadamized ground to maintain its equilibrium. These wheels hardly touch the ground or planks, as the vehicle is so built that nearly the whole weight of it rests on the wheels running on the rail. The animals also draw the wagon in the ordinary way, being ahead of it instead of being put on the sides, as Mr. T. L. Hadden proposes. The application of Mr. Larmanjat's system to the establishment of railroads in France, on common turnpikes, has proved quite a success, and I will try to give you an idea of it.

He starts with the idea that the railroads, as they are established now, with two rails and the wheels of the locomotives and cars wedged or otherwise solidly fixed to the shafts, are on a wrong principle, and create a considerable resistance in the curves, which might have been avoided by establishing the road with a single rail put in the same plane with the longitudinal axis of the locomotive and cars. He criticises also the drawing on the rails. As only forty per cent. of the weight of the engines and tenders goes on the driving-wheels, and as the adhesion or friction produced by that weight between the line of the wheels and the rails is considerably smaller than it would be on a macadamized road, he says that the adhesive power of the engines necessary to draw the train is only obtained by increasing their weight considerably, especially when the road has heavy grades, and that sixty per cent. of that weight is constantly carried by the locomotive, and does not at all increase the tractive power due to the adhesion on the rail. He illustrates by an example the difficulty that the engine and cars encounter in going around a curve.

Take a wheelbarrow, says he, and in place of the one wheel that it has in front in its longitudinal axis, which allows it to change direction so easily, put on a transverse shaft in front of the wheelbarrow two wheels, one at each end, and have them loose on the shaft. You will soon find that the arrangement which does well enough for moving in a straight line won't do when you want to change direction; and if you wedge the wheels on the shaft, it will be still worse. To change direction you will have to use an extraordinary force proportionally with the load. The wheel which has to run the outer or greater curve will have to slide, as, being wedged on the shaft, it will not have the same facility to turn as if it were loose on it. In building the railroads with two rails and fixing the driving-wheels of the locomotive and those of the cars on the shaft, the same mistake, he thinks, has been made as if wheelbarrows were built with two parallel wheels fixed on one shaft and wedged to it.

His invention consists in causing the driving-wheels of the locomotive to work on a macadamized road or on planks of oak timber laid parallel to the rail, which gives him undoubtedly a power of traction six or seven times greater than on iron, and in causing the whole train, locomotive and wagons, to run on a center rail. The rail he uses is the Vignoles or American rail. It is spiked on the middle part of ties laid transversely to it, and the planks of oak are fixed by bolts on the end of the ties and laid parallel to the rail.

For a railroad established on a turnpike having a grade of five feet per hundred feet and on which the train weighs 50 tons and the locomotive ten tons, the ties are 5 feet 7 inches long and a little over 3 inches thick, and the oak planks parallel to the rail are 16 inches wide and 3 inches thick. If on such a turnpike and to draw the same weight the driving-wheels are made to run on a macadamized road-bed instead of on plank, the rail, instead of resting on ties, would rest on oak planks one foot wide and three inches thick and extending in the same direction as the rail. The macadamized part of the road would be about one foot wide on each side of the rail. The planks and part of the rail would be buried in the ground. The rails employed would be very light, weighing only 8½ pounds per lineal foot.

The locomotive has four wheels. Two of them are placed, one at the front the other at the back end of the engine, and bear on the rail. They are in a longitudinal plane passing through the middle of the rail and engine. These wheels are to give the direction. They are double-flanged to keep them on the rail. The two other wheels are in a transverse plane passing in front of the fire box. They bear on oak planks or a macadamized road-bed and are the driving-wheels. By a mechanism as simple as ingenious, consisting of a screw in front of the engine which enables the driver to incline it more or less, the weight of the engine can be thrown at will more or less on the driving-wheels. They are not wedged nor fixed solid on the shaft in any way, but can, before starting the train and in the curves, turn loose on the shaft. They have coiled springs, one end of which is fixed to the shaft and the other end to the hub of the wheel, so that the engine moves only after a certain number of revolutions, the spring coiling itself till the tension is equal to the power necessary to start the train. With this disposition, when the engine runs in a curve, one of the springs discharges itself of all the difference that the wheel has to run greater than the other wheel, so that the tension of the shaft and the sliding of the wheel, which cause so much resistance in the two-rail system, is avoided. The directing wheels running on the rail can, by means of a pivot, turn in any direction.

The carriages or wagons have likewise four wheels; two of them bear on the rail and two on the road, and they have the same disposition as in the locomotive, with this difference, that all the weight bears on the rail, and the side wheels, which are of a smaller diameter than the directing wheels, are there only to keep the equilibrium. They are loose on the shaft. The resistance to the traction of the wagons is thus, in a straight line, very nearly the same as on an ordinary railroad. The directing wheels of the wagons are, like those of of the locomotive, able through a pivot to take any direction. The train can run through curves of 16 feet radius, that is to say, pass easily from one direction to another perpendicular to it.

This invention is considered by several competent men as the true solution of the problem of establishing railroads on turnpikes with the grades and curves that common roads commonly have now. Mr. Larmanjat has established a railroad of his system near Paris, between the Rainey and Montfermeil, which has been worked for two years, on which he goes up grades of seven feet in the hundred, or 370 feet a mile, and goes through curves of 16 feet radius with a locomotive weighing 3 tons and drawing two wagons containing twenty passengers each. This railroad has proved a success. It cannot be denied that he has considerably less resistance on the curves than he would have on a two-rail railroad. If an ordinary cart driven on a common road had its wheels wedged on the shaft, instead of being loose, it would take to draw it around a curve ten times as much power as on a straight line, and if the cart had its two wheels placed one behind the other in its longitudinal axis, with two other wheels in the

middle merely to maintain the equilibrium, the whole weight of the cart resting on the two first wheels, it would turn a great deal easier in the curves, especially if those wheels were working under pivots. With two rails the resistance on the curves is considerable. If it is 10 pounds on a level railroad in straight line for a load of a ton, it will be 30 pounds, or three times greater, on a level road in a curve of 1,000 feet radius for the same road. To show the advantage of his system, Mr. Larmanjat compares the work of two locomotives weighing 7 tons each, one working on two rails, the other working on one rail only. In the first case the engine will have a driving power equal to the seventh of its own weight, or to one ton. The one working on a macadamized road will have a tractive power of three tons and a half; that is to say, that on a level the first one will drive only a train of 180 tons, while the other would drive one of 650 tons. If the road has heavy grades, such as 5 feet per hundred, the advantage of the one-rail system will be still greater. To produce the same traction it would be necessary on two rails to have a locomotive of 24 tons, and the power necessary to draw the locomotive itself would cause that the engine would draw only 30 tons up that grade. The one working on a macadamized road and weighing only 7 tons would drive a train of 50 tons up the same grade.

The ordinary system of two rails could not be laid on a turnpike or common road. It would be too expensive, necessitating heavy engines, heavy rails, excellent ballast, extremely solid bridges, culverts, etc. The heavier the grades, the heavier must be the engines on such a track.

With an engine weighing 5 tons working on one rail Mr. Larmanjat can obtain as much and more adhesive power of traction than with an engine weighing 40 tons working on two rails. He can go up grades from 3 to 5 feet per hundred feet with it, drawing, besides the weight of the locomotive, a weight of fifteen tons—a result which could never be obtained with such a light engine on the ordinary system of building railroads.

He can construct his railroad in France on a turnpike or common road for $1,600 a mile. He has two types of locomotives. One weighing six tons will draw at a speed of 14 miles an hour, besides its own weight, a train weighing 35 tons, and will go up grades of two feet per hundred with that load. It costs in France $4,000. The second type of engine weighs 10 tons. It can draw on a grade of two feet per hundred a train weighing 50 tons at a speed of 8 miles an hour. It costs $5,000. It would draw on level a train of 180 tons.

The price of wagons is as follows: Passenger coaches, 1st and 2d-class, with 20 seats, $1,100; 3d-class wagons, $920; baggage cars for 5 tons of baggage, $640; flat cars for 5 tons load, $500.

I, as well as several competent engineers, favor this system of Mr. Larmanjat for railroads on turnpikes or common roads, let the motive power be steam or animals. I was corresponding with him before the European war broke out, and it was his intention to have me represent him in this country and establish a railroad on his system. As he lives in Paris the war interrupted our correspondence, but I am trying to communicate with him again. When arrangements are completed between us, my intention is to form a company to establish his railroad on turnpikes or common roads.

In building a railroad on Larmanjat's system, by having the distance between the lateral wheels of the cars smaller than that between the driving-wheels of the locomotive, it would be possible to lay a line of flat bands of light iron on the inside edge of the oak planks so that the driving-wheels of the locomotive would travel on the oak, and the lateral wheels of the wagons run on the bands of iron. This, I think, would be an improvement. I also think that the mode of causing the driving-wheels of the locomotive to run might be improved. Instead of a coiled spring, I would suggest that there be placed on the shaft, between the hubs of the wheels and the frames, two pieces, one on each side of the engine, which should slide on a key fixed on the shaft and catch at will in the hubs of the wheels and cause the wheels to revolve with the shaft, as the keys fixed on the shaft would cause those sliding pieces to revolve with the shaft all the time. The sliding motion of those coupling pieces would be operated by a forked lever, whose end would be above the frame and would be worked by a screw whose nut would be fixed on top of the frame. The steam power might be used to turn that screw. In starting the train the wheel would be coupled with that piece, and in the curves the whee. running on the outer curve should be uncoupled and become loose on the shaft, which would facilitate considerably the motion in the curves. The motion would be communicated directly to the shaft by means of cranks put on the shaft and connected with the wheels by those coupling pieces. On the curves, one wheel at least thus running on the inner curve would certainly, if it ran on macadam or planks, draw the train with the whole force of the two cylinders applied to it, while the other wheel, being loose on the shaft, would follow the motion by turning and would not slide on the planks, which, is of considerable importance to diminish the resistance to the traction in the curves.

CH. J. QUETIL, C. E.

ELKHART, Ind., April, 1871.

CANADA SOUTHERN RAILROAD.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The prospectus of this railroad, which has appeared in the public prints, is an interesting document; but as there are some very important points connected with that scheme not referred to in the prospectus I propose to supply them.

The *prospectus* refers to an *entire line from Buffalo to Chicago*, but contains the financial scheme only for the *portion in Canada*. If the Canada portion is laid and the Michigan portion collapses, the line in Canada having no connection would necessarily be a local line only—out in the cold.

But let us take it for granted, for argument's sake, that the entire scheme from Buffalo to Chicago will be completed. It will then simply mean a new railway which will run alongside the new Air Line of the Great Western, in Canada, and the old line of the Michigan Southern, in Michigan, and therefore have to compete for every pound of not only its through traffic but its local traffic also.

It would, if completed, be 50 miles longer from Chicago to New York than the Pennsylvania Central, and would be only 7 miles difference in distance from the Michigan Central and Great Western. But in addition to the Pennsylvania Central and the North Shore routes, it would have a most formidable competitor in the Lake Shore and its New York Central connection, besides the outside lines, such as the Baltimore & Ohio and the Grand Trunk, which, being long lines, always cut the rates on the shorter lines, as, not being able to make *the time*, they have to give an advantage by charging *less money*.

The claim, therefore, that the Canada Southern will be 28 miles shorter than the North Shore (the Michigan Central and Great Western) is an entire mistake. In Canada the new Air Line which the Great Western is constructing will be close alongside the proposed Canada Southern, and will be only 227 miles long; and as the shortest possible Air Line that can be built through Canada would be 225 miles, it is out of the question to admit that the Canada Southern can shorten the distance.

Now let us look at the prospect for profit of the Canada Southern. For its whole distance from Buffalo to Chicago it will meet the competition of the Great Western in Canada and the Michigan Southern in Michigan, for every pound of its local business. But the local business, which all the great railroad lines consider their salvation, is looked upon in the Canada Southern prospectus as of no value. I think most of the railroad men engaged on the great east and west lines would be likely to tell you that without a good local business they could not possibly carry the through traffic at the ruinously low rates now obtained; but the Canada Southern expects to live entirely on such sustenance.

Now as to the estimated earnings, which they make $5,000,000 per annum. I think $1,500,000 would be nearer the mark, and my reasons for arriving at this conclusion I will give. I go so far as to take it for granted that the Michigan portion of the line to Chicago may be built; without it of course they could have no through traffic, as the Lake Shore will never work against itself at Detroit; as well might we expect the Pennsylvania to divert its through traffic north at Crestline to go by the Michigan Southern, as expect the Lake Shore to divert its traffic north from Toledo to go *via* this Canada Southern when it has its own line through to Buffalo—and the Michigan Central is virtually one with the Great Western, with their extended alliance. To return to the figures:

The Great Western in the year 1870 earned	$4,000,000
Fifty-five per cent. of this was through and 45 per cent local. These are the figures published in their reports	
Fifty-five per cent. of $4,000,000 equals	$2,200,000
Half to Canada Southern	$1,100,000
Forty-five per cent. of $1,000,000 equals $1,800,000; one-fourth to Canada Southern	450,000
Total to Canada Southern	$1,550,00

Now no reasonable man will claim that the Great Western with its two through lines (one connecting at Niagara Falls, the other at Buffalo) will not earn half the through traffic across Canada, which, as shown by the published reports of the Great Western, is, as stated, $2,200,000. The moonshine of anticipated increases of $1,000,000 per annum in this prospectus is dispelled, when it is found by the reports of the Great Western Company that this through traffic in the year 1870 yielded just $20,000 less money than it did in 1869. So much for allowing the Canada Southern half the through business—a very liberal estimate.

Then as to the local traffic. I give them one-fourth of that, and base this calculation on the fact that the Great Western has 350 miles to earn its local traffic of $1,800,000 upon, while the Canada Southern has only 287 miles; and the Great Western runs through and serves every large city and town in Ontario, while the Southern, in its whole distance, does not go through or near a single town of 1,000 inhabitants except St. Thomas (with its 1,700), which will also be served by the Air Line of the great Western.

These reasons will amply justify the estimate I have made, that the total earnings of this line, if built, will not exceed $1,500,000, 75 per cent. of which would be through business carried at about one cent per ton per mile. At this rate, I claim, and I think it will be confirmed by any railway man, that the Canada Southern's working expenses cannot be less than 60 per cent. The statement would then stand:

Earnings	$1,550,000
Expenses	930,000
Net	$620,000

which would yield a dividend of *less than four per cent.* on the proposed amount of the capital of the line, $16,000,000, as shown by the prospectus. Why, if we give the Canada Southern credit for double the figures herein shown, they cannot earn the interest on the eight millions of bonds they propose to issue.

A few words about the St. Clair Branch, which it is proposed to run from St. Clair, alongside the poor-paying Grand Trunk, to Detroit, and then to enter the city of Detroit over the Detroit & Milwaukee, a line owned by the Great Western! This is about as weak as the balance of the scheme.

I think the foregoing a fair and liberal estimate of what the future of the Canada Southern is likely to be, if ever built through to Chicago; but what would be the position of the bondholders, if the Michigan section of this scheme collapsed? Why, they would be in about the same predicament as the unfortunate English shareholders of the Grand Trunk Railway are in.

April 20, 1871. VINDEX.

A CHEAP RAILROAD FOR LIGHT TRAFFIC.

BALTIMORE, April 24, 1871.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In your number of April 15, in an article entitled "Narrow-Gauge in Iowa," you express the hope that the gentlemen engaged in the investigation of the "narrow-gauge" will not confine their attention to that subject, but will investigate the question of cheap railroads generally. You forcibly add that we need a system of light roads for a light traffic as feeders to heavier lines, and that it is essential that these be proportioned to the work they have to do, and especially that they be *cheap*. You, kindly, invite a discussion of this vital subject of cheap transportation, and in furtherance of your wishes I submit for your consideration the following described system of railway, knowing that if it have any practical merit it will readily be perceived, and if not, it will as readily be discarded.

Our ordinary railroads are far too costly for our farming country, and what is needed is something of a railway far less expensive in construction and management—something which shall combine the carrying capacity of the railroad with the cheapness of the common country road. Can this capacity and economy be combined? Can the farming country have a system of railway which it can practically control and operate for its own advantage?

Will not a single-rail tramway, laid and used as described, meet this requirement, especially for the farming country of Illinois, Indiana and Ohio?

The single rail tramway is no untried novelty; it has been successfully operated with animal and steam power. In August, 1868, a single-rail line was constructed by M. J. Larmanjat, and according to the *Annales Industrielles*, a 3-ton engine drew over it two wagons up a long gradient of 1 in 14 and round curves of 16 feet 5 inches radius. Several lines have since been constructed in Portugal, and recent accounts speak of their satisfactory introduction in the thinly populated portions of India. In India they are operated by animal power on gradients of 1 in 40.

To meet the requirements of our farming country, I would propose the following single-rail tramway, which is substantially the "Larmanjat system" adapted to our wants and requirements.

The bed of an ordinary country road is taken, and on this road-bed are laid—as on a railroad—cross-ties, say 4 feet long, 5x7 inches, at the distance of 2 feet 6 inches apart from center to center, and upon these

cross-ties a single rail of U pattern is laid, of the weight, say, of 25 lbs. to the running yard. If the country road-bed be firm, *this will constitute all of the permanent way.* If not firm, the portion of the country road traversed by the side-wheels must be made firm. To accomplish this, various materials would be used. If wood were abundant, longitudinal sleepers would be put down; these timbers to be regulated by the traffic of the road and the tractive power employed. Limestone would be used, or any of the slates or sandstones, refuse and cinders from furnaces, and waste from coal mines, shells and gravel, or any material which would give a firm bearing to the outside wheels.

The carriages or wagons have four wheels, similar to the ordinary car or farm wagon, and in addition have two grooved wheels, which rest and run on and along the single rail described. These wheels are so adjusted by springs that the chief weight of the wagon is upon the central rail, without removing the outside wheels from the roadway, as the outside wheels serve to steady the car or wagon. The engines employed have the same wheels as the cars or wagons—the driving-wheels resting on the ordinary road-bed, and with them the central rail serves principally as a guide rail. Increased adhesion is gained for the engine, and tractive resistance is lessened in the car or wagon. Larmanjat uses two engines. One class, weighing 10 tons, is capable of drawing a load of 50 tons up an incline of 1 in 50 at a speed of 6 miles per hour; the second class, of 5 tons, capable of drawing a load of 35 tons up an incline of 1 in 50 at a speed of 10 or 11 miles per hour, or, by changing the speed, of hauling the same load up a gradient of 1 in 20.

These results seem perfectly satisfactory, and meet fully the requirements of our farming country.

As an estimate of the cost of one mile of line of single-rail tramway, laid as described, I would submit the following:

25-lb. rail, with cross-ties, spikes, joint fastenings, track-laying, sidings, and ballast for rail, with country road-bed sufficiently firm for the outside wheels, $2,800.

When road-bed is not sufficiently firm, and stone, cinders, gravel or other material are employed, say $3,300.

When road-bed is not sufficiently firm and timber is employed, say $3,600.

These estimates would necessarily vary in different sections.

The rolling stock for the Larmanjat system is admirably adapted for the service. As an improvement upon the system, and as an economy required by our farming interest, I would propose that the "box car" and "gondola" be substituted by the farm wagon, so that every farmer would have and own his own rolling stock. This is the fruitful source of expense and delay in the present system.

Every farmer has a good broad-wheeled farm wagon, and under the single rail system this farm wagon may be made to serve the part of rolling stock. By this system every farmer would have a branch line running into his barn, and with his own line and switch, rolling stock and tractive power, he would be independent of the delays and changes incident to our costly system of railroads.

W. N. BOLLING,
Engineer, Baltimore & Ohio Railroad.

SIMPLE RULES FOR LOCOMOTIVE ENGINEERS AND MACHINISTS.

[Continued from Page 38.]

SUMMARY.

RULE 1—TO OBTAIN THE CIRCUMFERENCE OF A CIRCLE.

Multiply the diameter, in feet, or in inches, by 3.1416, pointing off four figures for decimals: the product is the circumference.

RULE 2—TO OBTAIN THE AREA OF A CIRCLE.

Multiply the diameter by itself, and multiply the product by .7854. Point off four figures from the product for decimals, and it will represent the area.

RULE 3—TO REDUCE VULGAR FRACTIONS TO DECIMALS.

It is so often necessary to know the decimal equivalent to ⅛, ¼, and other vulgar fractions, that we append the rule for finding it in each case: Add ciphers to the numerator, or upper terms of the fraction, and divide it by the denominator, or lower term. Point off as many places from the quotient for decimals as there have been ciphers added to the numerator. Ciphers may be added until there is no remainder, or until the quotient has been carried to three or four places of decimals.

RULE 4—TO OBTAIN THE TRACTIVE POWER OF A LOCOMOTIVE.

Multiply the diameter of one cylinder by itself; multiply the product by the length of stroke, in inches, and multiply this product by the effective pressure, in pounds, per square inch. Divide the last product by the diameter of the wheel, in inches: the quotient is the tractive power, in pounds. The effective pressure must be estimated, or measured by an indicator. If estimated, 75 lbs. per square inch is a safe allowance.

RULE 5—TO OBTAIN THE ADHESIVE POWER OF AN ENGINE.

Divide the weight on the drivers, in pounds, by 6; the quotient is the adhesive power. An engine is well proportioned in respect to cylinder capacity and adhesive weight, when the adhesive power is equal, or nearly so, to the tractive power found by Rule 4.

RULE 6—TO FIND THE NUMBER OF TONS OF LOAD WHICH A GIVEN TRACTIVE POWER WILL DRAW ON A LEVEL.

Multiply the speed, in inches, per hour, by itself, and divide the product by 6. The quotient is the whole atmospheric resistance, in pounds, to the train, and may be deducted from the tractive power. The resistance of friction and of concussions must be next ascertained for one ton. Friction is constant, at all velocities, and is 6 lbs. per ton weight of train. The concussions of the flanges against the rails, and the end friction of the journals are believed to increase with the velocity, being ⅓ lb. per ton at one mile an hour; 3⅓ lbs. at 10 miles per hour; 20 lbs. at 60 miles, and so on. Hence, for the concussion divide the speed, in miles, per hour, by 3. The quotient is the resistance of concussions, in pounds, per ton. This must be added to the friction resistances, viz., 6 lbs. per ton, and the tractive power, after deducting the atmospheric resistance, must be divided by the amount. The quotient will express the number of tons which may be drawn at the given speed by the given tractive power.

RULE 7—TO CALCULATE THE GRAVITY OF ONE TON ON ANY GRADE.

Multiply the rise of the grade, in feet, per mile, by the decimal .4242; the product will express the pounds of gravity of one ton of 2,240 lbs. on such grade. For tons of 2,000 lbs., multiply by .3787 instead of .4242.

RULE 8—TO FIND THE LOAD WHICH A GIVEN TRACTIVE POWER WILL DRAW ON A GRADE.

Proceed as by Rule 6, as far as to dividing the tractive power by the sum of the friction and concussions. Before this division, ascertain the gravity of one ton on this grade, by Rule 7, and add it to the friction and concussions, dividing the tractive power by the amount as before.

RAILROAD FARMING.

BY WM. S. HUNTINGTON.

We often hear it remarked by foreigners who are traveling in this country for the sake of seeing it, that our railroads present a very slovenly, forsaken appearance, compared to what "we 'ave at 'ome," as our cousin John would say. And Americans who have traveled on English, French and German roads are struck by the pleasant and sightly appearance of the grounds adjoining railway stations and along the line between stations. The grounds belonging to the company are cultivated by the operatives in their leisure hours, and well kept vegetable and flower gardens are the rule, while here they are the exception. There is no reason why the vacant grounds around a railroad station should not be cultivated, both for profit and appearance, as well as a suburban city lot. Indeed, there are very strong reasons for the officers and employes of our railroads taking a more lively interest in farming or gardening than has been the case heretofore. Never since the first mile of railroad was put in operation in this country has there been so much money expended by railroad companies for making travel by rail *pleasant* as at the present time. This is not altogether owing to the greater mileage, but there seems to be a general disposition to look after pleasure-travel that has not been manifested heretofore. It is a common thing at the present day to see a railroad company expend from $15,000 to $20,000 for a palace or drawing-room car in excess of an ordinary comfortable coach. In fact, the last account we have gives the cost of some drawing-room cars at $25,000 above the cost of an ordinary passenger coach, and all this for the comfort of passengers. Any road supplied with four of these cars will have expended the sum of $100,000 for this object. Of course this will be appreciated by the traveling public, and will no doubt swell the receipts from passenger traffic on all roads provided with these cars. The traveling public, especially those who travel for pleasure, are not slow to appreciate any effort made by the railroad community in their behalf, and any line whose pleasure travel is such as to warrant the expenditure of large sums for luxurious cars for the especial accommodation of the pleasure-seeker, cannot do better than to encourage such of their employes as are conveniently located, and have leisure, to cultivate such grounds as are adapted to the purpose, and are not wanted for other purposes. It is not necessary that a railroad company should expend a large amount of money in improving their grounds so as to please the eye of the traveler. This would be done by the employes if they were encouraged by the managers, and thousands of travelers would have a more pleasing recollection of a pleasure trip over any of our roads when they recalled to memory the sight of a cabbage garden by the road-side in the wilderness, than by a remembrance of the silver mountings and costly trappings of the car in which they made their trip.

Railroad travelers in this country are pleased with our scenery, and well they may be; but when we view a range of lofty mountains in the distance, and almost go into ecstacies at the grandness of the sight, our pride and our ecstacies vanish when we bring our line of vision down to objects in our immediate vicinity. It is on our roads that "distance lends enchantment to the view." There are, however, thousands of miles where a view of distant objects is shut out by forests; and the traveler must content himself with the hope that he may sometime "get out of the wilderness," where a view of distant objects will afford him some relief. Nothing has a more depressing influence on the spirits of the weary, homesick traveler than the unsightly appearance of the grounds around the stations covered with brush and trash of every description; buildings and fences in a dilapidated condition, all combine to give one the "blues." A little gardening around a station gives an appearance of thrift, and is a source of pleasure to the traveler such as cannot be afforded by any amount of costly trappings on the interior of a coach. It is astonishing what an amount of money a railroad company will expend to "make things pleasant" at their city stations, to the entire neglect of even providing for a moderate degree of comfort at way stations.

But it is not altogether for the purpose of pleasing travelers that I would urge railroad men to "farm it" along their line: there would be no small degree of profit as well as pleasure derived from a judicous amount of labor expended in cultivating the fertile strips of land which are to be found on most of our roads. The profit would not be altogether that of the employe who performed the labor, but would be shared by the stockholder. There are many villainous clay cuts that give the company "heaps of trouble" and expense by sliding down and filling the ditches on the occurrence of every rain, all of which may be prevented by seeding the slope with clover, which will effectually prevent wash or sliding. Embankments may also be similarly treated, when they will withstand any amount of heavy rains without injury. Mr. Murphy, the switchman, will be glad to cut and secure the clover to winter his cow, or, if it is too far from his headquarters to make it pay, the farmers along the line would be glad to harvest it, thus leaving the ground clear of a carpet of dead, dry grass to take fire in the spring, as is often the case, and which is the cause of the destruction of thousands of dollars' worth of property. Setting out trees for the protection of embankments does not seem to have the desired effect, but seeding to clover seems to effectually prevent wash or sliding. It would seem as though evergreens would make a good snow fence, if set out for that purpose. It would not be a very costly fence either to build or keep in repair. It would certainly be effective as a snow fence, and other hedge trees might be introduced to make the fence proof against farm stock.

—The San Francisco *Bulletin* of the 24th inst. announces the winding up of the long and successful career of the California Steam Navigation Company, as follows: The negotiations which have been pending for some days between the California Pacific Railroad Company (the Vallejo route) and the California Steam Navigation Company have been completed, and the latter corporation will pass over its entire possessions, boats, franchises, and real and personal property of every description, to the former, within a few days. The California Steam Navigation Company has for many years controled all the bay and river routes in the State of California, and until within the last two years monopolized the entire freight and travel between the city of San Francisco and the chief towns of the interior. The completion of the California Pacific, Western Pacific, San Jose and Central Pacific Railroad branches, one after another, has materially cut down the business of the California Steam Navigation Company of late, but it has still retained a large and profitable trade, and the stock has been held firmly in the market. The proceeds of the sale now announced will be divided among the stockholders, and the company will then disincorporate.

—Boats commenced locking on the Buffalo Division of the Erie Canal on the morning of the 24th inst., and before five o'clock on that day, 100 boats, with 675,000 bushels of grain, had cleared.

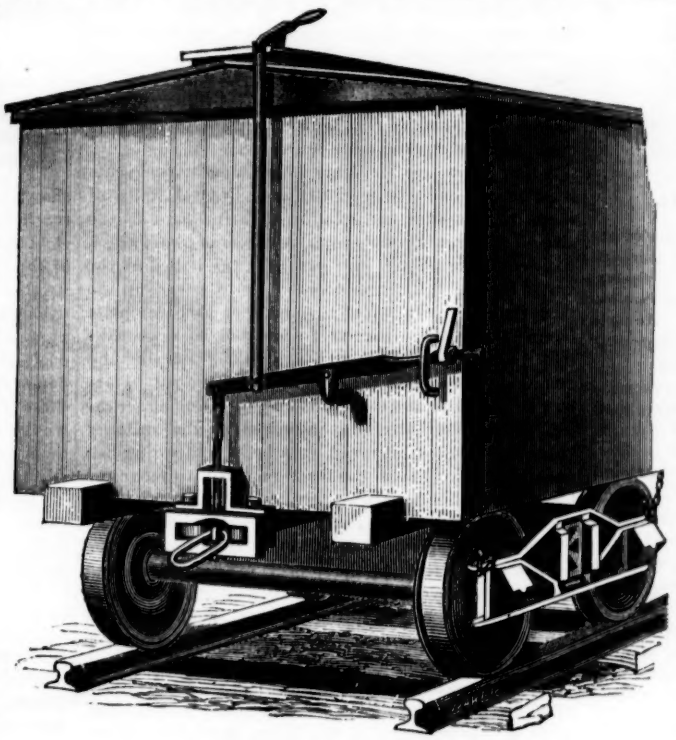
REX'S CAR COUPLING.

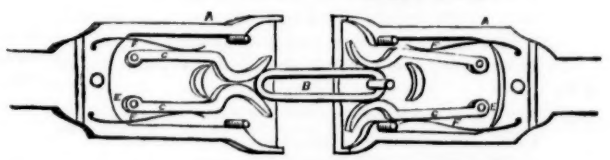
The engravings below show very clearly the arrangement of the parts of a new car coupling, as well as its working when attached to a freight car. No substitute is offered for the old arrangement of the link and pin, but some devices are added in order to make the coupling automatic, and avoid the necessity of the brakeman placing himself in any position of danger for the purpose of either coupling or uncoupling cars or making a "running switch." The buffer-head is made hollow, as represented, and a little wider than usual, in order to provide room for the curved spring jaws, the ends of which, near the mouth of the buffer, are widely separated so as to receive the link when forced in, and guide it to the proper position to receive the pin. These jaws may be arranged as shown—pivoted at the rear ends and provided with springs to press them together—or the jaws themselves may be springs, rigidly connected at the rear ends to the sides of the buffers.

Before the link is inserted the lower end of the pin rests on top of the jaws, so that when the jaws are pressed apart by the entering link the pin drops by its own weight and effects the coupling. The pin is continued to a connection with a lever at the top of the car, and may also be withdrawn by means of a spring-catch lever extending to the side of the car—in neither case requiring the operator to place himself upon the track.

A retaining catch is shown, attached to the lever near the corner of the car, which may be set so as to prevent a dropping of the pin when the cars come together. The use of this will be found advantageous in making up trains when it is not desired to couple them at first.

Further information in reference to the invention may be had of the patentees, Messrs. W. A. & J. M. Rex, Jr., Butler, DeKalb County, Indiana.





MECHANICS AND ENGINEERING.

Platte River Bridge.

Mr. J. B. Moulton, Chief Engineer and General Superintendent of the Omaha & Southwestern Railroad is engaged in making surveys for the bridge over Platte River about seven miles from the junction with the Missouri River. The Nebraska Legislature has offered 20,000 acres of land to aid the undertaking. One location that has been made, but not yet finally decided upon, requires one span of 150 feet over the first channel; three spans, in all 500 feet, across a tow-head of Cedar Island; 400 feet over the main channel; 1,000 feet of trestle work on the island, and 800 feet of trestle work on the south bank—in all 2,850 feet. In crossing the main channels, the engineers have partially located the bed-rock at a distance of 60 or 70 feet below the bed of the river. With the exception of one strata of coarse gravel and loam, with perhaps another of bituminous shale, this deposit upon the bed-rock is a fine sand.

Delaware & Hudson Canal Reservoir.

It is reported that the company have purchased a large tract of land in Sullivan County, about seven miles from Wurtsboro', upon which is Lord's Pond, a large inland lake. Upon this land they have commenced the construction of an immense reservoir, which will be fed by waters from the pond, and, in time of need, will add its supply to the canal, and prevent even such a drouth as that of last year from affecting transportation. The reservoir will cover 209 acres. The dam will be 923 feet in length, and 23 in height, giving a "head" of 20 feet. It will require, above the base line, 7,000 cubic yards of earth for the sloping embankment above the dam, and 3,000 yards of dry masonry and 320 yards of cement masonry for the bulkhead. The work will cost, it is estimated, about $15,000.

The Baltimore & Ohio Shops.

At the Mount Clare shops of the company they are busy building ten-wheeled freight engines, of what will seem to railroad men of a higher latitude somewhat peculiar construction. They are ten-wheeled engines, with six driving-wheels 50 inches in diameter, and have cast-iron tires, which are used exclusively on this road. The distance from the center of the back driving-wheels to the center of the truck is only 15 ft. 4½ in. This makes it necessary to place all the driving-wheels ahead of the fire-box.

The cylinders are 19 in. diameter and 22 in. stroke, and are inclined at an angle of about one in six. The valve gear is the old double-expansive valve, worked by eccentrics and hook motion. The cab is on top of the boiler, and the fire-box is inclined downward from the top of the barrel of the boiler. The crown-shut is stayed with stay-bolts, the same as the sides of the fire-box. The grate is 59¼ in. long × 42¼ wide. The boiler has 134 2¼-in. tubes, 14 ft. long. The shell is 48 in. in diameter, made of ⅜-in. iron, and double riveted all through. The fire-box is made of steel, with the exception of the tube-shut, which is made of copper.

These engines weigh 73,000 lbs. in working order. We could not learn the relative weights on the drivers and on the truck.

Although these locomotives may appear somewhat antiquated, yet, after long experience with freight engines of different kinds on this road, it was thought that those of the plan described gave better results than any others. It must be remembered, too, that they are obliged to work on curves of 400 feet radius, for which they are especially adapted by the shortness of their wheel-base.

The first engines of this plan were designed by Mr. Samuel J. Hayes, now Superintendent of Machinery on the Illinois Central Railroad, in 1853 or 1854.

The Baltimore & Ohio Company has built ten of them for the Pittsburgh & Connellsville Railroad, which has just been opened.

About 1,500 hands are now employed at the Mount Clare shops.

Ingenious Instrument for Measuring.

M. Eckhold is the inventor of an ingenious instrument, called the omnimeter, designed for measuring distances, altitudes and angles. It consists, first, of a graduated circle to read off each ten seconds in the measurement of horizontal angles; second, of a powerful telescope revolving in a plane perpendicular to the graduated circle; third, of a microscope of high powers, connected with the telescope and moving with it; fourth, of a highly sensitive level, lying upon a rule of a fixed length, say twenty centimeters; fifth, of a scale fixed vertically at the extremities of the rule, at a distance coincident with the optical axis of the microscope, which scale is divided into half millimeters, from 1 to 200; sixth, of a microscopical screw movement, connected with the base of the scale, and giving the two ten-thousandths of a millimeter, legible on the graduated scale beneath; and, seventh, of an extremely sensitive level, capable of being applied to the telescope and of determining, when required, its horizontal adjustment.

The leveling staff, used with the omnimeter, is not divided, but is of an invariable length, which is defined by two white lines on a black ground, one at the upper end and the other at the lower extremity. The omnimeter is found especially useful in difficult and hilly localities, where leveling in the ordinary way becomes a tedious operation, because the sights are short and are multiplied in proportion to the rapidity of the decline. With this new instrument, also, the levels may be taken at much greater distances apart, even where considerable angles are made with the horizon. The omnimeter embraces all the advantages of the theodolite and level, and does away with tedious chain measurements; its operation requires, too, no complicated calculation.—*St. Louis Republican.*

RAILROAD LAW.

***Common Carriers.**—Liability for goods missent, when chargeable with knowledge of facts known to some of the agents.*

The facts in the recent case of *Cougar et al. vs. Chicago & Northwestern Railway Company*, 24 Wis., 167, are as follows: The plaintiffs shipped by defendant's road trees and other nursery stock from Whitewater, Wis., directed to "Iuka, Iowa," the consignees being resident in a village of that name in Tama County, Iowa. At Chicago the goods were shipped by defendant's agents by the Chicago, Burlington & Quincy Railroad Company, and at Quincy were transferred to the Quincy & Missouri Railway, by which they were transported to Iuka, in Keokuk County, Iowa. In consequence of this mistake, they were alleged to have become worthless, and this action was brought to recover damages.

The Court holds that the principle of "notice to the principal, notice to the agent," could not apply and says:

"Notice, to the agents in Iowa, distant some two or three hundred miles from the City of Chicago, who had distinct duties to perform, and were not at all concerned in the business of forwarding the goods from Chicago, was not such notice as will bind the company in relation to that business, the same having been transacted by other agents, who had no such notice; * * * * and it would seem to be an obvious perversion of the doctrine, and to lead to most injurious results, if in the same transaction the principal were likewise to be charged with the knowledge of other agents, not engaged in it, and to whom he had delegated no authority with respect to it, but who were employed by him in other and wholly different departments of his business. The answer of the company alleges that the place was unknown to the officers and agents of the company at Chicago; that they were informed that said Iuka was situated in Keokuk County, in the State of Iowa, and near the line of the Burlington & Missouri Railroad; that they examined a map of Iowa used by shippers, and kept in the office of defendant, for the purpose of ascertaining where said Iuka was situated; and that said map represented said Iuka as being in Keokuk County aforesaid. The answer further alleges that the goods were directed to 'C. E. Cox, Iuka, Iowa' without giving the name of the county, or other directions to indicate to what part of the State, or to what railroad station in the State, the same were consigned, or by what line of railroad the same were to be forwarded. It appears to this court, therefore, upon the pleadings, that no cause of action for negligence is stated against the company, but that if there was negligence on the part of any one, it was upon the part of the plaintiff in not having marked the goods with the name of the county or otherwise with that of the railway station or with the line of road by which they were to be sent. The demurrer to the answer should therefore have been overruled; and the order sustaining must be reversed and the cause remanded for further proceedings according to law."

***Damages.**—Effect of custom as to the use of cow-catchers.*

In the United States Circuit Court for the State of Maryland, Judge Giles recently gave the following instruction to the jury in the case of the suit against the Northern Central Railroad Company for $20,000 for the death of a conductor:

"If the jury shall find, from the evidence in the case, that defendant never attached cow-catchers to the rear car of any of its trains, and that, in running its construction, or gravel cars, it frequently ran backward with the engine at the rear of the train, and shall further find that this was well known to Samuel Becker when he accepted the position of conductor of one of such trains, then plaintiff cannot recover in this case, although the jury may find that the accident in the case would not have happened if the rear car in the said train had been provided with a cow-catcher." The jury, under these instructions, rendered a verdict in favor of the defendant.

RAILROAD GAZETTE

PUBLISHED EVERY SATURDAY.

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Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Inventions.—Those who wish to make their inventions known to railroad men can have them fully described in the RAILROAD GAZETTE, *if not previously published,* FREE OF CHARGE. *They are invited to send us drawings or models and specifications. When engravings are necessary the inventor is expected to furnish his own engravings or to pay for them.*

Engineering and Mechanics.—Communications and correspondence relating to these subjects should be directed to M. N. Forney, No. 72 Broadway, New York. Subscriptions and advertisements will be received at the New York office, and any other business transacted with those to whom that office is most convenient.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

☞ *Our Prospectus and Business Notices will be found on the last page.*

POWER REQUIRED TO MOVE SLIDE-VALVES.

A correspondent writes us: "Of course you know "that much power is lost by steam pressure in every "slide-valve engine; but its simplicity compels its "adoption on locomotives and elsewhere, where com- "plicated machinery like a Corliss engine or a Missis- "sippi steamboat lever engine cannot be used. If a "freight engine has slide-valves of say, 9x15 inches, "or 135 square inches at the usual working pressure "of 130 lbs., each slide-valve must drag 17,500 lbs. back "and forth in each steam chest 8 to 10 inches, or about "35,000 pounds, before it performs any duty at all * * "* * * * * What I want to know is, what will be "saved by doing away with this enormous load dragged "in each steam chest?"

The inquiries which our correspondent makes are not easily answered. In the first place the amount of pressure which is borne by a slide-valve, or which is due to the steam above and is in part counteracted by the steam below, or the pressure in them, we believe has never been satisfactorily determined. It is well known that steam produces no pressure on a valve, unless there are openings under it in which there is a less pressure than that of the steam. Experiments have frequently been tried demonstrating this point, and showing that a valve will slide on a face without ports as easily in a chest filled with steam of a high pressure as it will in the open air. From this fact it has hastily been inferred that the pressure on the valve was due to, or rather attributable to, the size of the ports. What the relation is which exists between the total pressure on the valve and the area of the openings under it, or whether they are in any way proportional, has never, to our knowledge, been clearly demonstrated. It seems very doubtful whether the pressure is in any way dependent on or affected by the *size* of the openings. If we take the two plates and fit them to each other by grinding or scraping, so as to have an air-tight bearing, and then place them one on top of the other, they will not adhere to each other unless pressed together with considerable force, showing that there must be more or less air remaining between them (no matter how well they are fitted), and which requires to be forced out before they will be held together by atmospheric pressure. Supposing now that, instead of pressing them together, we drill a hole of ¼ inch diameter in the lower plate. If now we exhaust the air from this hole, it is obvious that any thin film of air which might remain between the plates would probably be exhausted through this hole, and that very soon the air on top would press on the whole surface of the plate. Of course it is possible for the plates to be very slightly convex around the hole, in which event the air between them would be excluded by an air-tight joint from being exhausted, and the pressure on the plates would be only that due to the area of air-tight bearing surface. Probably this is the case with nearly all valves, *i. e.*, the pressure is dependent on the accuracy with which they are fitted to each other, and the amount of pressure varies with the wear and the quantity and kind of lubrication which they receive. It is of course true that whatever film of steam there might be under a valve would be more likely to leak out and be exhausted by a long port extending across its face than by an opening of very small extent; and in that sense the size of the port might affect the pressure on the valve.

A few years ago Mr. Hayes had some experiments tried on a locomotive in the Illinois Central Railroad shops to determine the relation of the pressure to the size of the openings or ports. A cast-iron plate, which was accurately planed and scraped, was bolted on the valve face of the locomotive, so as to cover up the ports entirely. On top of this another cast-iron plate having 165 square inches area was fitted, so as to make it as near steam-tight as was possible by scraping and grinding. The plate that was bolted to the valve face had no openings, and there was no D opening under the top plate. The latter was attached to the ordinary valve-stem and was moved by a lever and spring-balance, which indicated the force required to move the top plate. This force was very irregular; at times the spring-balance would indicate very great resistance, and then suddenly spring back 30, 40 or 50 lbs., so that the only way to determine the power exerted in moving the valve was to average as nearly as possible the tension indicated by the spring-balance. From this was calculated the amount of power exerted by the lever on the valve-stem in moving the valve.

Without steam this power was 34 lbs. When steam of 40 lbs. was let into the chest, the valve moved backward by the pressure of the steam against the valve-stem, which was 1¼ inches in diameter. An opening ⅜ of a square inch area was made under the valve and leading into the exhaust port, with the following results:

With a steam pressure of 38 pounds per square inch the power required to move the valve was	121¼ lbs.
With a steam pressure of 45 pounds per square inch the power required to move the valve was	112 "
With a steam pressure of 80 pounds per square inch the power required to move the valve was	173 "

The opening was then made equal to ¾-inch area:

With a steam pressure of 45 pounds per square inch the power required to move the valve was	120 lbs.
With a steam pressure of 70 pounds per square inch the power required to move the valve was	163 "
With a steam pressure of 85 pounds per square inch the power required to move the valve was	190 "

The opening was then made equal to 1⅛ square inches area:

With a steam pressure of 70 pounds per square inch the power required to move the valve was	192 lbs.
With a steam pressure of 75 pounds per square inch the power required to move the valve was	222 "

After the last experiment the area of the valves was reduced to 123¾ square inches, or 25 per cent., the opening remaining the same, *i. e.*, 1½ square inches area; then,

With a steam pressure of 45 pounds the power required to move the valve was	120 lbs.
With a steam pressure of 50 pounds the power required to move the valve was	136 "
With a steam pressure of 80 pounds the power required to move the valve was	180 "

The opening was then increased to 4½ inches area with the following results:

With a steam pressure of 45 pounds per square inch the power required to move the valve was	120 lbs.
With a steam pressure of 60 pounds per square inch the power required to move the valve was	172 "
With a steam pressure of 70 pounds per square inch the power required to move the valve was	172 "

We have no record showing whether the surfaces were lubricated with oil or not.

We quote these experiments, not because they are conclusive in establishing any law in relation to the pressure on slide valves, but more on account of their negative character. They show clearly that the pressure on the valve is not in proportion to the size of the openings under it, and the last two series indicate that with small openings the size of the valve has little influence on the pressure on it. It is very strange, too, that the force exerted in moving the valve or plate did not increase in proportion to the steam pressure. It seems probable that the form of the opening may very much affect the extent of the area of the surface of the valve and face which are in contact, and which, therefore, have a steam pressure on them. It would, in this connection, be interesting to know what power would be required to move any given valve with a round hole of 1 sq. in. area, and a slot ⅛ in. wide and 8 in. long.

Altogether, it seems probable that the pressure and the resistance depends to a very great extent upon the condition of the surfaces of the valve and face, and, considering the extreme variations of temperature and consequent really unstable character of two masses of cast iron, such as a cylinder and valve of a locomotive engine, it seems improbable that any regular or fixed coefficient of friction for a slide-valve can be determined, or really exists. This, we have been informed, has been the experience of Mr. Ericsson, who tried some experiments on slide-valves some years ago.

Another experiment which serves to complicate the problem more is, that at times all ordinary slide-valves have more or less pressure under them, which varies with the motion of the valve and other conditions of working. Take, for example, a valve in the position shown in the cut. It is represented as having just reached the point of release of the steam from the port, *A;* consequently there is a pressure on the under side of the valve due to that of the steam in the port and its area, and also to the pressure of the steam in the exhaust cavity. As the point of release has been reached at *A*, the compression takes place almost simultaneously at *B*. Therefore the back pressure in the cylinder will be exerted under the valve at *B*. Of course these pressures vary as the valve moves, so that it would be an exceedingly complicated problem to follow them, except by indicator experiments, on both the steam and exhaust sides of the piston.

Therefore, until some much more accurate experiments are made in relation to this subject, it will be impossible to calculate, with any degree of certainty, the power required to move a slide-valve.

Dead Weight of Passenger Trains.

The following data with reference to the weight of passenger trains on the Chicago, Burlington & Quincy Railroad will be interesting and probably useful to many of our readers. The figures can be relied upon, and are not the result of guess work, which, we regret to say, is so often the case with railroad statistics (for example, see the State Engineer's Reports on Railroads). The weight and capacity of the express trains are as follows:

	Weight, lbs.	*Capacity.*
One engine and tender	105,000	
Two 8-wheel bag'age crs at 33,000 lbs.	66,000	
Two 8-wheel pas'ger cars at 38,0 0 lbs.	76,000	Seats for 108
Two 12-wheel p'sng'r c'rs at 48,000 lbs	96,000	Seats for 132
One 12-wheel'd pas'nger car	50,000	Seats for 66
One 12-wheeled sleeping car	54,000	Double berths, 24
One 16-wheeled sleeping car	60,000	Double berths, 28
Total	507,000	358

The passengers carried on this train number from 280 to 340, but average about 300, which would make the paying weight as follows:

Three hundred passengers averaging 140 lbs	42,000 lbs.
Baggage	12,000 lbs.
Express matter	12,000 lbs.
Total	66 000 lbs.

Which will make a proportion of dead to paying weight of 7.682 to 1. This includes the weight of engine and tender.

The lightest passenger train run on the road is their "mail," the weight of which is as follows:

	Weight, lbs.	*Capacity.*
One engine and tender	100,000	
One 8-wheeled mail car	32,000	
One 8-wheeled baggage car	36,000	
One 8-wheeled passenger car	36,000	Seats for 54.
One 8-wheeled passenger car	38,000	Seats for 54.
Total	242,000	Seats for 108.

The passengers carried in this train, our informant says he has counted many times, and that they average about fifty, which will make the paying weight as follows:

Fifty passengers averaging 140 lbs	7,000 lbs.
Mails	2,000 lbs.
Baggage and express	10,000 lbs.
Total	19,000 lbs.

This gives a proportion of dead to paying weight of 12.74 to 1.

This is a very favorable showing for American railroads; but it must be remembered that the Chicago, Burlington & Quincy can make a better report in this respect than most other roads. The amount of travel on their line is so great, and so nearly uniform, that

their cars can be well filled; but it must also be remembered that the cars are somewhat heavier than on other lines. We will be glad to receive reports similar to the above from other roads.

The Detroit Tunnel.

We are informed that this great work, plans of which were published in the RAILROAD GAZETTE a year ago, is to be constructed as soon as possible, and that work will be commenced immediately.

It may not be amiss to refer here to some of the leading features of this work. It will enter the ground on the Detroit side, near the present station of the Michigan Central, and extend northeastward about 2,000 feet nearly parallel with the river. Thence it turns by a curve of about 60 degrees to and under the river, the curved portion being about 2,500 feet long. Thence the course is straight for about 2,200 feet and nearly to the Canada shore, whence a curve of about 50 degrees and about 1,800 feet long brings it to the open cutting on the Canada side in a direction parallel to the river. The entire length of the tunnel under ground is to be 8,568 feet, or about 1 3-5 miles. There are to be, in fact, two tunnels, parallel to each other, one for each track, it being esteemed cheaper to make two than one large enough for two tracks. The estimated cost of the work, including right of way and track laid with steel rails, is $2,650,000. The engineer believes that it can be completed within two years.

It becomes every year more and more necessary for the Michigan Central and Great Western to improve their means of transit at Detroit River. The stream is not too wide to be bridged—about half a mile—but a bridge high enough to clear the masts of the vessels sailing on the lakes would be very costly, and the commerce is so great that a draw-bridge would need to be open almost constantly during the season of navigation. A charter has been obtained for the tunnel, and authority to construct it from both the United States and the Dominion of Canada.

The Michigan Central and the Great Western.

A party of the directors of the Great Western Railway of Canada are now in this country, and it is reported that they have concluded an arrangement with the managers of the Michigan Central, by the terms of which the entire through earnings are to be put into a joint purse and then divided. This arrangement is to last for twenty years. The arrangement is similar to that which has been in force for a year past, but, we believe, is more sweeping, though the details have not yet been made known. Last year's arrangement, though a great benefit to both companies, was not altogether satisfactory, and some amendments were desired which have probably been provided.

The effect is that the two roads form virtually one great line, with common interests, between Chicago and the Niagara River, connecting at Suspension Bridge with both the New York Central and the Erie, and soon to have a connection at Buffalo with the same roads. It will always command a large share of the traffic between the West and the Atlantic coast, and with the control which the owners of the Michigan Central exert over thousands of miles of the most valuable roads west of Chicago, it is not easy to see how the construction of any new lines or the formation of new combinations can materially affect the fortunes of the great North Shore route.

The Texas Pacific Railroad.

In a previous article on the meeting of the corporators of this company for organization, some misstatements were copied which the following will serve to correct:

Marshall O. Roberts presided over the meeting for organization, being nominated for the place by General John C. Fremont. In accepting the position, Mr. Roberts made a speech, in which he said that he would accept the management of the company and undertake the construction of the road, if he should be permitted a controlling interest and freedom from interference in his designs. He was, by a vote moved by Thomas A. Scott, President of the Union Pacific, permitted to subscribe for 11,000 of the 20,000 shares of the company. General Fremont was permitted to subscribe for 5,000 shares, and the remaining 4,000 shares were apportioned equally among the corporators present, about seventy in number. All the stock was taken on the spot, and 10 per cent. paid in It was generally understood and agreed that Marshal O. Roberts should be President of the company. It has been reported that Thomas A. Scott is a one-half owner of the shares for which Mr. Roberts subscribed.

This meeting for organization was held on the 15th inst. Two days later, on the 17th, a meeting for the election of directors and officers was held. It was determined, however, to postpone such an election until the Chairman, Mr. Roberts, shall call a meeting for that purpose, after fifteen days' notice in the newspapers.

The following is the speech of Mr. Roberts at the meeting for organization:

"GENTLEMEN—My object is to build this road across the State of Texas to the Pacific Ocean, and so to conduct the enterprise that no man shall have just cause of complaint, and so that every promise may be faithfully kept. This I cannot do unless you give me the power to do it. I am never able to work out great results unless I can work in my own peculiar way. If I am to be embarrassed at every step I can be of no use to myself or to my friends, and the undertaking will be one of failure and disgrace, instead of honor and success. I know that the difficulties will be great, and that many will arise which cannot be foreseen; and it is now impossible to tell what will be necessary to do in emergencies. I shall not disappoint you in the result if you give me your confidence and the power to gain the ends which we all desire.

"The people of Texas have confided in me in a manner which I deeply appreciate. My interests in that State—connected with the Southern Pacific road, the Transcontinental and the El Paso roads, and in other ways—are so great that if I should imperil them by adding the Texas Pacific road, over which I could have no control, the anxiety and the burden would be more than I could bear.

"To be of any use in the great enterprise, I need associated with me men upon whom I can rely in the trying times which are sure to come; men whom I personally know. To build this road and carry it through with prompt success would be an honor to which I might aspire, but to fail would be a disgrace which I cannot risk.

"If you will permit me to subscribe for myself and associates eleven thousand shares of the capital stock, being a controlling interest in the company, I will enter upon the work with my whole heart, and endeavor so to manage it as to disappoint no reasonable man; but if that is not desired, I wish you all success, but I will be unwilling to assume a burden which I could not otherwise sustain.

"In conclusion I beg also to say that I am ready and perfectly willing to advance the ten per cent. required for 2,500 shares of stock for General John C. Fremont."

There is, doubtless, a great deal of wealth represented by the stockholders of this company, but they are not men who are likely to lavish any considerable part of this wealth unless they are pretty sure that they will get it back with interest. That the entire road is likely to earn a large interest on its cost does not seem probable. Through business is now light when one road has the monopoly of it; before the Texas Pacific is built it will have the competition of the Northern Pacific as well as the existing line, and then, too, the Honduras Railroad will have improved the ocean route. That the through business will increase is quite probable, but it is hardly possible that it will increase as fast as the facilities for transporting it. Texas will be able to give a good traffic to the eastern part of the road, but not much can be said for a great part of the line west of the Rio Grande.

Street Car Accidents.

From a report submitted to the Board of Health of New York, we learn that out of eighteen accidents on the street cars, eleven occurred when the person was getting off the front platform. Six, or 33⅓ per cent. of the accidents, were fatal. The committee recommend the adoption of an ordinance compelling the railroad companies to inclose the front platform so completely that neither the step nor hand-rail will be accessible from the outside.

Illinois Railroad Laws.

Governor Palmer has signed the bill regulating warehouses and that regulating the transportation of grain by railroads, and they are now laws. He has vetoed the bill authorizing the taxation of Illinois Central Railroad lands, as unconstitutional. The Senate passed the last-named bill with but one vote in the negative, that of Senator Jewett, of Chicago, who at the time made a speech setting forth the unconstitutionality of the bill.

REGISTER OF EARNINGS.

FOR THE SECOND WEEK IN APRIL.

Michigan Central (284 miles), 1871	$92,606 61
" " (284 miles), 1870	86,573 25
Increase (7 per cent.)	$6,033 36
Earnings from all sources	$102,891 56
Chicago & Alton (511 miles), 1871	$103,605 04
" " (466 miles), 1870	86,432 90
Increase (20 per cent.)	$17,172 14

—The Appleton *Times* says that Wisconsin is now looming up as the great iron-producing State of the Union. Four ranges of hills, each twenty miles long, running parallel with the Menominee River, have been found to contain immense quantities of almost solid iron, and are estimated to contain ten times more of that metal than all the Lake Superior range combined.

THE GREAT WESTERN OF CANADA.

Report for the Half-Year Ending December 31, 1870.

The Great Western Railway of Canada extends from Suspension Bridge west to Windsor, opposite Detroit, 229 miles, with a branch from Hamilton, 43¼ miles west of Suspension Bridge northeastward to Toronto, 37¾ miles; and a branch from Komoka, 130 miles east of Suspension Bridge, westward to Sarnia, with a short branch to Petrolia, 5¾ miles. It operates under a lease the Erie & Niagara Railway, extending from Fort Erie, opposite Buffalo, northward along the west bank of the Niagara River to Niagara Wharf, near the mouth of that stream, 31 miles, connecting with the Great Western 19 miles north of Fort Erie at Suspension Bridge; also the Galt & Guelph Railway, which extends from a junction with the Great Western at Harrisburgh, 62 miles west of Suspension Bridge, northward 28 miles to Guelph, and the Wellington, Grey & Bruce Railway, an extension of the last-named road from Guelph northward to Alma, 23 miles. The earnings and expenses of the leased lines are reported separately, and the earnings and expenses given in the report are from the 332½ miles of road owned by the company.

The report below is signed by Thomas Dakin, the President of the company:

The receipts on capital account during the half year to 31st January, 1871, amounted to £549,333, as follows:

On account of third installment of five per cent. preference stock	£197,053
Remaining installments on preference stock, in advance	2,033
Amount received on account of issue of £750,000 six per cent. bonds	492,450
	£691,536
Deduct four per cent. bonds, due 1st January, 1871, paid off	142,203
Leaving the balance receipts on capital account	£549,333

The total receipts on capital account amounted on the 31st January to £6,138,736. The outlay on capital account during the half-year amounted to £71,588, of which £45,124 has been expended on account of the Glencoe & Buffalo line. The remaining expenditure includes cost of four and a half miles of additional sidings at various parts of the line—increased cost of 3,000 tons of steel rails, as compared with iron rails—addition to station buildings—44 new gravel cars and 2 baggage cars, being additions to stock—balance of expenditure on five new locomotives, etc., the details of which are shown in the Engineer's and Mechanical Superintendent's reports. The total expenditure to 31st January amounted to £5,579,543, leaving a balance of £559,192 at the credit of capital account. The receipts and expenditure on revenue for the half-year have been as follows:

Gross receipts		£444,348
Working expenses, including renewals and all charges		267,481
		£176,867
From which is deducted—		
Interest on bonds (less interest received)	£42,400	
Discount and charges on conversion of American funds	17,360	
Loss on working Erie & Niagara Railway	523	
Amount set aside for renewal of ferry steamers	3,000	
		63,284
		£113,583
Add profit on working Galt & Guelph Railway	£1,220	
Amount accruing to this company under agreement with the Michigan Central and Detroit & Milwaukee railroads for division of through earnings during the year ending 31st December, 1870	3,196	
Balance from last year	3,302	
		7,719
Available for dividend		£121,302

The dividend for the half year on the five per cent. preference stock amounts to £13,149, leaving a balance of £108,152. From this balance the directors recommend the payment of a dividend for the half-year on the ordinary shares at 6 per cent. per annum, payable in London on 26th April, which will absorb £104,371, and leave a balance of £3,780 to be carried forward to the next half-year. The renewal fund for the ferry steamers amounts to £21,728. The discount and charges on the conversion of American currency for the half-year amounted to £17,360, as compared with £37,156 in the corresponding half-year. The average rate of conversion has been at the rate of 113⅛, the average price of gold having been in the same period 116. The amount of assets in American funds at 31st January was $322,584, as compared with $220,120 at the commencement of the half-year. The following table exhibits the receipts and expenses for seven corresponding half-years:

	Receipts.				*Expenses.*	
Half-year ending.	*Passengers, mails, and sundries.*	*Freight and live stock.*	*Rents.*	*Total.*	*Including renewals.*	*Per cent. of gross receipts.*
January, 1865	£154,125	£157,873	£739	£312,729	£168,576	53.91
January, 1866	205,131	181,071	836	387,039	170,093	43.93
January, 1867	168,985	161,254	1,273	331,513	166,622	50.26
January, 1868	186,536	213,476	799	400,812	193,666	48.31
January, 1869	183,702	238,763	845	423,311	209,752	49.55
January, 1870	183,740	239.5 5	906	424,182	248,379	57.37
January, 1871	173,169	270,463	715	444,348	267,481	60.19

The aggregate traffic receipts, compared with the corresponding half year, exhibit a gross increase of £20,355 as follows:

Increase in way passenger traffic	£6,388
" way, freight and live stock	5,561
" mails and express	56
" through freight and live stock	25,366
	£37,372
Decrease in through passenger traffic and emigrants	17,015
	£20,357

The following is a summary of the revenue results of the past half-year, as compared with those of the corresponding period of 1870:

	1871.	1870.
Passenger earnings per mile:	*Cents.*	*Cents.*
Receipts per way passenger	2.707	2.612
" through passenger	2.304	2.491
Freight earnings per mile:		
Receipts per ton way freight	3.340	3.319
" " through freight	1.369	1.471
Average receipts per train mile	$1 90	$2 10
Ordinary working expenses	1 11	1 16

The cost of ordinary working expenses per train mile for seven corresponding half years, is as follows: 31st January, 1865, 5s. 1½d. sterling; 31st January, 1866, 4s. 6¾d.; 31st January, 1867, 4s. 7¼d.; 31st January, 1868, 4s. 5¾d.; 31st January, 1869, 4s. 3¾d.; 31st January, 1870, 4s. 9½d.; 31st January, 1871, 4s. 6½d. Following the policy indicated last half-year to maintain the permanent way in a thoroughly efficient condition, the amount expended upon the reconstruction of the track has been £14,140 in excess of the outlay for the corresponding half-year, and for the twelve months £44,077 in excess of that for the corresponding twelve months. All this extra expenditure has been borne by revenue. 3,000 tons of Bessemer steel rails, and 3,325 tons of rerolled iron rails, of a superior quality, have been put into the road during the half-year. The attention of the proprietors is called to the fact mentioned in the engineer's report, that during the past fifteen months 111 miles of the main line have been relaid with steel rails, or with an excellent quality of iron rails, the cost of which has been charged to revenue, with the exception of the difference in value of the above 3,000 tons of steel rails over iron rails. The engineer also reports that this increased expenditure will be materially reduced during the current half-year ending July 31st, 1871. During the past winter a very large traffic has been worked over the line, with great regularity and almost entire freedom from casualties. Since the last report was issued the important policy of changing the gauge from 5 feet 6 inches to that of 4 feet 8½ inches has been proceeded with. During the past half-year the third or outside rail has been removed, leaving a single narrow-gauge track between Windsor and Komoka, 99¾ miles; Hamilton and Suspension Bridge, 43¼. The gauge of the line between Hamilton and Toronto has been narrowed from 5 feet 6 inches to 4 feet 8½ inches (37¾ miles), and the gauge of the Sarnia, Petrolia, and Guelph branches (83¼ miles) will be changed as soon as possible, so as to enable the alteration of all the car stock to the narrow-gauge. The triple line of rails will for the present remain down between Komoka and Hamilton (86½ miles), where the remaining broad-gauge engines will be kept employed until they are replaced by narrow-gauge. It will be observed that steps are being taken to dispose of or convert the broad-gauge rolling stock, and it is proposed that the balance of the cost of altering the gauge and providing the necessary narrow-gauge rolling stock in substitution of the broad-gauge, shall be charged to revenue, commencing next half-year, and extending over a period of not exceeding five years; meantime the cost will be carried to "Alteration of Gauge Suspense Account."

The tripartite agreement between the Great Western, Michigan Central and Detroit & Milwaukee railways, arranged by the last deputation to Canada, by which all the through traffic of the three companies is divided in certain proportions on the one-purse system, has worked satisfactorily. The Port Huron & Lake Michigan Railway is in course of construction by an American company from Port Huron, opposite Sarnia, to Owosso, where it connects with the Detroit & Milwaukee Railroad. It will be ninety miles in length, and will run through one of the best-settled portions of the State of Michigan. When completed, this line, in connection with the Great Western, will afford a shorter communication between the West and the East by forty miles. An agreement has been entered into by which the through traffic of this new line is secured to the Great Western. A certain portion of the additional traffic earnings which it will bring over the main line will, under this agreement, be applied to the acquisition of the first mortgage bonds of the new road, similar in every respect to the arrangement sanctioned with the Detroit, Hillsdale & Indiana Railroad, as mentioned in the report for the half year to January 31, 1870. On January 21st last a branch line was opened from Suspension Bridge to the city of Buffalo, constructed by the Erie Railway Company, affording a connection eastward by that line, in addition to our present connection by the New York Central Railway, which has already produced a very satisfactory addition to the weekly traffic. It has been deemed desirable to revive the project of making a short branch from Harrisburgh Station, on the main line, to the town of Brantford, for which enabling powers were granted by the Legislature so far back as 1855. The length of this branch is 7½ miles, and the cost will be within $150,000, towards which the town of Brantford contributes, as a free gift or bonus, the sum of $75,000. The line will terminate at the canal basin of the Grand River navigation, where the bulk of the grain business of the town is concentrated. Contracts have been let for the works of the Glencoe & Buffalo line for 103 miles of this railway. These contracts have been taken at prices within the engineer's estimates. The arrangements are not quite completed for the additional 46 miles between Canfield and the International Bridge into Buffalo. The result of the account kept of the traffic exchange between the Great Western Railway and the Wellington, Grey & Bruce Railway for the last six months shows that a sum of $7,609.16 can be applied to the acquisition of the bonds of that company, and in like manner a sum of $522.73 for the acquisition of the bonds of the Detroit, Hillsdale & Indiana Railway. The receipts and expenditure of the Detroit & Milwaukee Railroad for the year ending December 31, 1870, were as follows:

Gross earnings		£292,012
Working expenses, taxes, etc	£188,609	
Interest on bonds, etc	81,033	
		269,643
		£22,368

The construction of new lines across the Detroit & Milwaukee Railroad at several points has caused a large falling off in its local earnings, and the net revenue, after providing for interest on the first and second mortgage bonds of the company, has been expended on capital account, and therefore will not permit of the payment of any dividend on the preference shares held by this company. The freight traffic (both through and local) shows a satisfactory increase since the begining of the present year. The directors are gratified that the favorable anticipations expressed in the last report are in course of realization; the most beneficial results are expected when the alteration of the gauge and rolling stock now in progress is fully carried out.

MISCELLANEOUS.

—The Dubuque *Times* says that the highest land in Iowa, at Spirit Lake, is 17,000 feet high—2,000 feet higher than the highest mountain in the United States, outside of Alaska, where Mt. St. Elias rears its lofty head; but the Dubuque *Times* has a cipher too many in its figures for Spirit Lake, and only just enough for Mount St. Elias. The highest land in Iowa is about two miles and a half lower, and not 2,000 feet higher, than the highest mountain in the United States outside of Alaska, and companies who wish to construct railroads near this famous lake, as the Des Moines Valley Company is about to do, need not fear any extraordinarily heavy work to overcome grades.

—The exports of rails from Belgium in 1870 amounted to 122,926 tons, against 136,186 tons in 1869, showing a decline last year of 13,260 tons. A falling off of about 15,200 tons occurred last year in the exports of Belgian rails to Russia. The exports to Italy also declined 9,000 tons; those to Turkey, 12,000 tons; those to England, 2,000 tons; and those to the Low Countries, 800 tons. On the other hand, the exports to the Zollverein increased nearly 20,000 tons last year; those to France also increased 2,400 tons; those to Sweden and Norway, 1,000 tons; those to Spain, 2,700 tons, and those to Egypt, 1,000 tons last year.

—Professor J. Young has recently brought the question of the education of the mining engineers before the Institution of Engineers for Scotland. His proposals for its amelioration are as follows: "1. Great improvement in secondary schools, especially in teaching arithmetic, geometry, elements of natural philosophy. 2. The establishments in some large towns, such as Liverpool and Birmingham, of colleges on the Scottish model, or on that of Owens College—fairly well endowed—giving chiefly scientific training, with a few special technical chairs. 3. The practical recognition of the value of scientific training by engineers who take pupils.

—A telegram describes as follows a contest between the Peoria & Rock Island and the Chicago, Rock Island & Pacific railroads at Peoria on the 24th inst.: "The trouble grew out of a contract which the two roads had entered into concerning the running on one another's track. The Chicago & Rock Island claims, it is said, that the other party did not fulfil its part of the contract, and, to retaliate, prevented it from starting out this morning by piling ties and rails on the track and running a train of cars across. Nothing was done till about 4 o'clock p. m., when the Peoria & Rock Island procured four or five engines and, hitching them together, tried to break through the obstruction by main force. The Chicago & Rock Island immediately run down three or four engines, and the novel spectacle of four engines butting against four more was presented. Both put on all their steam and pushed and hauled amidst the shouts and cheers of the large crowd assembled. The Peoria & Rock Island was finally successful, breaking through the obstruction and running over the road. Both sides then hauled off for repairs, and the matter will, probably, be adjusted before the courts."

—The Humboldt *Register* says that the Central Pacific Railroad Company has made a very liberal offer, and one which will enable every property owner in Winnemucca to procure shade trees free of cost. D. H. Haskell, town-site agent for the company is authorized to supply the citizens with 250 trees of the mulberry variety, and deliver them at the depot in that place free of cost, to all who will promise to set them out and care for them.

—Last week an iron screw steamer, named the City of Houston, was launched from the yard of the Pennsylvania Iron Works, at Chester. She was constructed by Messrs. Mallory, of New York, and is intended to run between that port and Galveston. The following are her dimensions: Length on load line, 216 feet; length on deck, 228 feet; breadth of beam, 33 feet; depth of hold, 23 feet; height between decks, 8 feet; estimated light-load draught, 7¾ feet; tonnage, 1,660 tons, or thereabouts. She is expected to prove an extraordinary fast boat, and her accommodations for passengers are of the first order.

Chicago Railroad News.

The Peteler Portable Railroad.

This railroad, which is still in operation near the corner of Twenty-second and Reuben streets, has been visited and inspected during the past week by a number of engineers and contractors. Provision has been made for the immediate manufacture of a quantity of the apparatus to supply some pressing orders, but a company will soon be organized to establish a manufactory in this city. Those who wish to satisfy themselves as to the convenience and economy of the system, should examine it where it is at work.

Chicago, Burlington & Quincy.

Next Monday the company will put a regular passenger train on the Mendota & Prophetstown Branch, which is 45 miles long. It has had the track down for some time.

Some time next week the part of the Fox River Valley Branch between Aurora and Geneva will be opened. It has a station at West Batavia, and there is, or is to be, a side-track between Batavia and West Aurora. The trains will run in connection with trains on the main line, and not through to Ottawa and Streator.

Michigan Central.

This week two Pullman sleeping coaches have been dispatched *through to Boston* by way of this road, and they were so well patronized by travelers that one might think there is room for a regular line between the two cities. The coaches are two new ones, the "Dayton" and the "Corinth," which were on their way to take their places on a daily line between Boston and Bangor, over the Eastern of Massachusetts and the Maine Central.

Illinois Central.

We note elsewhere the filling of the positions of President and General Superintendent, which had been vacant for about two months. These new appointments do not bring any change in management, for Mr. Newell, the new President, has performed the duties of President since Mr. Douglas' resignation, as Mr. Mitchell has performed the duties of General Superintendent while he has had the title of "Assistant General Superintendent," an office which, we presume, will not be continued.

Chicago & Alton.

The company will next week take a locomotive, by way of the Mississippi, to be used in the construction of the portion of the Louisiana Branch between the Mississippi and the Illinois. Tracklaying will be prosecuted from both ends towards the Illinois, and it is intended to have the line completed by the 1st of July. By the 1st of August it is expected that the Louisiana & Missouri River road will be completed as far west as Fayette, about one hundred miles from Louisiana, and twelve miles north of the Missouri River at Boonville, where it is possible that a connection may be made with lines south of the Missouri.

Mr. A. Allee, late Northern Passenger Agent of the North Missouri Railroad, has been appointed Eastern Traveling Agent of the Chicago & Alton, and will soon go to the East to enter upon his duties.

PERSONAL.

—Mr. Henry P. Boody, Local Treasurer at St. Louis of the Rockford, Rock Island & St. Louis Railroad, died of typhoid fever on the 11th of April. Mr. Boody was a son of H. H. Boody, Treasurer of the company.

—George Alfred Townsend writes as follows to the Chicago *Tribune* of General William Mahone, the great railroad man of Virginia:

"General Mahone, who is at the head of the Virginia & Southern Railroad system, a small, attenuated man, with the heart of a lion, is looked upon as one of the most powerful material men of the South, and he has a large salary from his railway interests; but his confidence in Southern securities has not enabled him to stand highest among capitalists in that region. This extraordinary little man, who figured in some of the most terrible panics of the war, as for example at the blowing up of the fort before Petersburg, where he led the way into the hollow crater to redeem the rebel line, never carried a sword or a pistol during the whole war, and went at the head of his troops with nothing in his pockets and nothing in his hands. His only weapon was his indomitable nature, and determination to be a leader. He was too weak to wield a sword had he possessed one, and he always forgot the pistol."

—Colonel William B. Johnson, a well-known railroad engineer, residing at Rockford, Illinois, died suddenly at the American Hotel, St. Paul, of an asthmatic chill, on the 21st inst.

—The ties used on South American railways have been drawn almost entirely from California, as the hard wood ties cut on the Andes cannot be used without boring the spike holes with augers. A great stock of California red wood ties has been piled up at Callao for future use on Peruvian lines. The original cost of a tie at San Francisco is 40 cents; but with freight and commission added, the charge is raised to $1 at Callao.

General Railroad News.

OLD AND NEW ROADS.

Municipal Aid in New York.

A bill which passed the New York Assembly on the 15th inst. by a vote of 82 to 24, provides "that any rail-" road in the State which exceeds 150 miles in length, and " which shall at the time of the passage of the act have " completed not less than one-fourth of its entire length, " and which, with its connections and branches, shall, " when completed, form a continuous line of railroad be-" tween the lakes Erie or Ontario, or the rivers Niagara " or St. Lawrence, and the tide waters of the Hudson " River, or which shall, for a distance of not less than " one-fourth of its entire length, run through an unim-" proved portion of the State," is entitled by the act to the sum of $10,000 per mile for every mile completed after the passage of the bill.

Evansville, Lake Erie & Southwestern.

Articles of association of this company were filed with the Secretary of State of Indiana on the 22d inst. Its purpose is to construct a railroad from Evansville northeastward through the counties of Vanderburg, Warrick, Pike, Dubois, Lagrange, Washington, Jackson, Jennings, Bartholomew, Decatur, Ripley, Franklin and Union, terminating on the line between the States of Ohio and Indiana, near the town of College Corner, where it connects with some road organized under a charter of the State of Ohio. The capital stock of the company is fixed at $4,500,000. George N. Carlton, New York; B. P. Pierce, Chicago; James E. Coe, Boston; F. Soule, New York; John H. Blish, Seymour; John S. Chandler, Evansville, and R. Pattison, Seymour, are the directors. The length of the route is about 210 miles.

Louisville, Cincinnati & Lexington.

The gauge of this railroad is to be changed immediately from 5 ft to 4 ft. 8½ in., so as to connect with the lines north of the Ohio. This is in accordance with an agreement made with the city of Louisville, and will make it necessary for all transfers to be made at Louisville, unless cars of changeable gauge are used, the roads south of Louisville having the 5-ft. gauge.

Newark, Somerset & Straitsville.

The completion of 24 miles of this Ohio road from Newark—which is on the Pan Handle line, 33 miles east of Columbus—a little east of south to Somerset, was celebrated by a grand excursion last Thursday. The road is to be continued 19 miles further south, to Straitsville, and part of the grading is ready. It is expected to have the whole 43 miles ready for operation by the first of September next.

Joliet & Northern Indiana.

The annual meeting of this company, which owns the line between Lake Station and Joliet operated by the Michigan Central, will be held in Joliet on Tuesday, the 30th of May, when an election of directors will be held.

Litchfield & Western.

It is reported that this proposed railroad, which is to extend from Litchfield, the junction of the Decatur & East St. Louis line with the Terre Haute, Alton & St. Louis road, westward through Carrolton to the Mississippi, will be constructed very soon, a difficulty concerning some of the bonds voted having been adjusted. It will form naturally a feeder to the Indianapolis & St. Louis line.

Burlington, Cedar Rapids & Minnesota.

The Charles City *Intelligencer* is informed that the Executive Committee of this company has made arrangements to complete the road by the 1st of September to Rockford, Floyd County, 50 miles northwest of the present terminus at Cedar Falls, and within 15 miles of Mason City.

Missouri, Kansas & Texas.

The track-layers and bridge-builders are at work on the line in the Indian Territory, between Chetopa and Fort Gibson. All the bridges on the line are made by the American Bridge Company. The bridge over the Arkansas River, above Fort Gibson, will be 900 feet long. The grading and masonry on forty miles between Chetopa and the Arkansas River have been done at a cost of $2,600 per mile. The road-bed is nearly ready for the iron as far as Fort Gibson, and the track is laid 22 miles into the Territory. The managers say they will lay nine miles of track per week for the next few months, and have the road completed to the Arkansas River by the 1st of July. A line of coaches run from the end of the track to El Paso, *via* Sherman.

Wisconsin Central.

A correspondent at Menasha writes to us: "Our road is progressing rapidly, about 1,000 men being on the work already. Next week we commence the location of about 50 miles of the line west from Stevens' Point, which is to be put under contract immediately. When the line west of the Point is located we shall proceed at once with the location and construction of the line between Stevens' Point and Portage City."

Great Western of Canada.

Mr. Brackstone Baker's announcement during the week that the directors have decided to recommend a dividend on the ordinary shares of the company at the rate of 6 per cent. per annum for the half-year ending 31st January, 1871 (the second half of 1870), subject to audit, must be received with satisfaction. It makes the dividend for the whole year 1870 5 per cent., which is very fair for a Canadian railway company to pay, and while 1870 pays at this rate, 1871 is producing a marked increase in the company's traffic.

For the last three years the dividends have progressed as follows:

Year.	*Per cent.*
1868	3½
1869	4¼
1870	5

Thus in two years the dividend has improved from 3½ to 5 per cent., or £1 10s. upon £3 10s., that is by upwards of 40 per cent. Very few English railway companies can show a progress equal to this.

But speaking of what the Great Western of Canada has already accomplished in late years, we should mention that while the dividend for the second half of 1870—that now in account—is at the sensible rate of 6 per cent. per annum, for the second half of 1863 it was but 1½, and for the second half of 1864 2 per cent. per annum. Comparing with the corresponding period of 1863, the present dividend is no less than four times the amount. A man who had then £150 income from his investment in Great Western of Canada shares would now have from the same investment £600! But we might put the case of improvement stronger than this. For the whole year 1864 the dividend was 1 per cent., while for 1870 it is 5. Thus the dividend of 1870 is 5 times the rate of that of 1864! "Poor, snowed-out Canada" can therefore do something.—*Herapath's Journal.*

Michigan Railroad Aid.

Both houses of the Michigan Legislature have passed a resolution to submit to the people a constitutional amendment authorizing the Legislature to provide for the payment of all railroad aid bonds delivered to the companies, and negotiated by them before the date of the Supreme Court decision in the Salem case. A proviso was attached that no municipality should be compelled to pay its bonds by consent of a majority of its "electors of three months continuous residence."

New Orleans, Mobile & Texas.

This railroad, which the New Orleans, Mobile & Chattanooga Company is constructing, and has been generally known as the "Chattanooga road," is completed from a point opposite New Orleans nearly due west up the Mississippi about 40 miles, and is to be completed to Donaldsonville, 57 miles from New Orleans, by the 1st of May, and the road-bed is ready for the ties 20 miles further. The road will probably be opened for business to Donaldsonville in July or August. For 20 miles west of New Orleans it is close to the Opelousas road.

European & North American.

The road is now in operation to Winn, 56 miles from Bangor, and 58 miles east of Vanceboro', on the New Brunswick line, where it will meet a line through that Province connecting with Halifax, now in operation. The road is to be completed by September. Then passengers across the Atlantic may take or leave steamers at Halifax and save 70 hours' voyage between that place and New York, a distance of 940 miles by rail and 700 by sea. From Halifax to Boston is 500 miles.

West Wisconsin.

The Tomah (Wis.) *Journal* says that on and after the first of May next, the West Wisconsin Railway will be managed as an independent line. Heretofore it has been operated by the Milwaukee & St. Paul Company.

Connecticut Western.

The company has bought rails, and will lay its track at once.

Boston & Albany.

The company has declared a semi-annual dividend of five per cent., payable on the 22d inst.

International Railway.

The commissioners for the construction of this great Canadian railroad, which is to unite the Grand Trunk with the Eastern Provinces, so that a line of railroad wholly within the Dominion will extend from Halifax to Quebec, Montreal, Toronto, Windsor, Sarnia, Goderich and Collingwood, advertise to let the contract for track-laying and ballasting for 23 miles from Riviere du Loup (the eastern terminus of the Grand Trunk) eastward, and also for 100 tons of spikes.

Ohio & Mississippi.

It is reported that the suit of the Erie Railway to restrain this company from changing from the 6 feet to the standard gauge has been amicably settled and withdrawn, and that mutual releases have passed between the two companies.

Plymouth, Kankakee & Pacific.

It having been reported that this road had been sold to the Chicago, Rock Island & Pacific Railroad Company, Mr. Singleton, the Vice-President, writes that that road "has not been sold to the Rock Island road, "nor has such an idea been entertained; and it will "not be diverted to Ottawa, but will be constructed "this season from Plymouth, Ind., to Bureau Junction, "Ill., all assertions by the enemies of the road to the "contrary notwithstanding."

Milwaukee & Nashua.

The route of this proposed road is from Chickasaw Station, which is on the Milwaukee & St. Paul's Iowa Division 85 miles from McGregor, southwest 7 miles to Nashua. This part of the road is located and $40,000 subscribed toward grading it. The line has been surveyed farther southwest, through Butler Center in Butler County, Ackley in Hardin County, Ames in Story County, and Polk City to Des Moines. Mr. E. P. Greeley, of Nashua, is President of the company.

Yazoo City, Raymond & Crystal Springs.

This company recently incorporated in Mississippi, proposes to construct a railroad from Crystal Springs, 25 miles south of Jackson on the New Orleans, Jackson & Great Northern Railroad, northward through Raymond, Bolton and Brownsville to Yazoo City, where it will connect with the proposed Memphis & Vicksburg Railroad for Memphis and Helena. The route is about 65 miles long. The incorporators are: O. Osborn, Fred. Dabney, Crystal Springs; L. W. Canaway, Dry Grove; H. T. T. Dupree, R. Charlton, Geo. Latimer, Raymond; Thomas Bolton, S. A. Baldwin, Bolton's Depot; N. H. Bradley, Brownsville; W. S. Epperson, Robt. S. Hudson, Hiram Harrison, P. P. Bailey, Yazoo City.

Narrow-Gauge Railroads in Missouri.

Announcements have been made of the formation of a company to build a narrow-gauge road from Iron Mountain east, 46 miles, to Grand Tower, on the Mississippi River; also of a company to build a narrow-gauge road from Cape Girardeau northwest, 30 miles, to a connection in Perry County with the Iron Mountain & Grand Tower road. The estimated cost of building this last road is $250,000, or about $8,000 per mile.

Central of New Jersey.

In the annual report, lately issued, the President, Mr. J. T. Johnston, gives the details of the lease in perpetuity of the Lehigh & Susquehanna Railroad. The number of the passengers carried during the year 1870 was 3,291,034, an increase of 994,170 over 1869. The gross receipts were $4,393,514.12 against $4,040,121.73 in 1869. The expenses were $2,512,216.64, a decrease of $129,946.73. One million two hundred thousand dollars of the $1,881,297.48 net earnings, were paid in dividends. The company has decided to relay the track with steel rails, and, to prevent such delays as occurred last year by the damage to the bridge across Newark Bay, will at once build a spur road from Elizabeth to Newark, thus giving them two independent avenues of communication with New York. The bonded debt of the company is $3,231,000. Of the passengers carried last year, 1,204,245 were between Newark and New York, and 708,582 between New York and Elizabeth; 134,521 were carried over the whole length of the road to and from Easton. The cost of the entire road, double-tracked, with coal-wharves, station-houses, shops and other appendages, stands at $10,630,122.60, and of the equipment at $2,674,000. The average receipts per mile were $1.87, against $1.81 in 1869, and the gross expenses $1.07, against $1.19 the previous year.

St. Paul & Sioux City.

This road, running from St. James, Minnesota, to Sioux City, Iowa, a distance of about 150 miles, is now under contract; fifty miles will be in running order by the 1st of August next, and the whole completed and equipped by the 1st of October, 1872. The road will be built for cash, the means having been already secured through the agency of Messrs. Aug. J. Brown & Son, Bankers, New York.

Niles & South Bend.

A railroad extending from the Michigan Central at Niles due south up the St. Joseph River to the Michigan Southern at South Bend, a distance of twelve miles is very nearly completed and will soon be in operation.

Pekin, Lincoln & Decatur.

Work on this road, which is leased to the Toledo, Wabash & Western, is being vigorously pushed forward. The rails are laid for about five miles in Logan

County, and it is expected that the road will reach Lincoln about the middle of May.

Chester & Tamaroa.

The Chester (Ill.) *Clarion* says: "Work upon the Chester & Tamaroa Railroad has now fairly been put under way at this end. Mr. Hawkes, the Chief Engineer, with a full corps of assistants, has been for two or three weeks making the final survey, and has permanently located the road about seven miles toward Georgetown."

West Wisconsin.

The Hudson *Star* says of this railroad: "We are informed that the line into the city, the route through, the depot grounds, etc., have been permanently located. We are also informed that work will be begun on the bridge in a few days. All contracts for grading require the work to be completed by the 1st of July."

Iowa & Pacific.

This company, which proposes to build a railroad across Iowa, between the lines operated by the Illinois Central and the Milwaukee & St. Paul, has made an arrangement by which it will be able to use the track of of the Dubuque & Minnesota road from the confluence of the Volga and the Turkey to Dubuque, about 40 miles.

Staten Island Shore.

S. Marsh, Jr., the President, has surrendered the property to the trustee for the bondholders, who has advertised the road for sale.

Delhi & Middletown.

Contracts were to be let this week for the construction of this railroad from Delhi, near the center of Delaware County, N. Y., northeast 31 miles to Margaretville.

Emmittsburg Railroad.

This road, which is to extend from Rocky Ridge, on the Western Maryland, northward seven miles to Emmittsburg, near the Pennsylvania line, is to be completed by next November.

Connellsville Cut-Off.

The Pittsburgh *Chronicle* says that the short link, only six miles long, connecting the Connellsville with the Allegheny Valley Railroad, will be constructed during the present summer. The road, as now located, will leave the main line of the Connellsville road at Nine-mile Run, and join the valley road *via* Negley's Run. This will cut off the sharp angle which the roads make in entering Pittsburgh, and save a detour of some 12 miles in cars going from one road to the other.

Atlantic, Mississippi & Ohio.

A meeting of the stockholders of the company is called for May 18, in order, it is understood, to arrange for building the extension from Bristol to Cumberland Gap, which is to connect with an east and west line across Kentucky with connections to Cincinnati and Louisville.

Jonesville, Marshall & Grand River.

A company at Marshall, Michigan—which is, we believe, the one with the name above—has been making a preliminary survey of the line from Marshall south, about 18 miles, to Girard, and the engineers are now making estimates of the cost. The Marshall *Statesman* has information that the directors will ask for proposals for grading as soon as the right of way can be secured, and that some responsible parties have offered to take the contract and pledge its completion within sixty days.

Evansville, Crawfordsville, Kokomo & Toledo.

Articles of association of this company were filed with the Secretary of State of Indiana on the 22d inst. The object of this association is to build a line commencing at the city of Kokomo, extending in the direction of Toledo, O., and traversing the counties of Howard, Grant, Wells, Adams, and, perhaps, Blackford, Miami, Huntington and Allen—a distance of about 75 miles, forming a line nearly parallel with and about 15 miles south of the Toledo, Wabash & Western. The stock of the company is fixed at $2,000,000. The preliminary survey is to be proceeded with at once.

Northern Pacific.

Construction trains are now running 30 miles west of the Mississippi, at Brainerd, and track is going down at the rate of a mile or two a day.

Iowa Narrow-Gauge Railroad Company.

The articles of incorporation of this company were filed in Des Moines on the 21st inst. The company has its office in Marshalltown, an organized capital of $2,000,000, and purposes to construct the road from Marshalltown; one northwest to Webster City, 60 mile; one southwest to Des Moines, 55 miles, and one southwest to Waterloo, 50 miles.

Laclede & Fort Scott.

The Chief Engineer, Mr. John Runk, in his annual report, gives the amount expended in Laclede County for grading, bridging, engineering, etc., as $69,798.40. With this amount about two-thirds of the road-bed in the county, 13.8 miles, have been completed.

In Dallas County the estimates for work done amount to $137,962.57 The grading is about two-thirds done, and a small expenditure would finish the road-bed for three-fourths of the distance from the Laclede County line to Buffalo, a distance of 14.8 miles. But little work has been done west of Buffalo, in Dallas County.

In Polk County, the work is progressing from one mile west of the Dallas County line to within one and a half miles of the town of Bolivar. There are about eighty men employed grading the road-bed in the county. The estimates for work done in this county amount to $24,245.16.

Texas & New Orleans.

The portion of this road between Liberty and Orange, Texas, is to be sold at Houston next Monday by the Master in Chancery. The affairs of the company have for some time been in the hands of a receiver, and on the line between Houston and Liberty a passenger train runs tri-weekly; on the part to be sold, no trains have been run since the war, and it consists chiefly of the right of way, a dilapidated road-bed, decayed and broken down bridge structures, and the rusty remains of part of the old rails.

Houghton & Ontonagon.

The Portage Lake (Michigan) *Gazette* of April 13 says: "Mr. Jacob Houghton, Chief Engineer of the Houghton & Ontonagon Railroad, returned the past week from his preliminary examination of a road-bed from the eastern end of Lake Michigammi to the head of L'Anse Bay. His reconnoissance of the country has developed an excellent route, where the grades will not be above the average, and but little excavating will be necessary."

Atlantic & Pacific.

The directors of this company have recently made an excursion over the road to Seneca, on the line between Missouri and the Indian Territory, which is the present terminus of the road. They made a trip in carriages into the Indian Territory to Grand River, about thirty miles west of Seneca, whence they returned by way of Baxter Springs and Kansas City.

Atchison & Nebraska.

Work has been commenced on the Nebraska extension of the road, from the State line north of White Cloud to Rulo, Neb., about five miles, where it will connect with the railroad already in operation westward to Falls City. The work is to be done in ninety days. From Falls City a line has been surveyed northwest to Lincoln.

Texas Railroad Aid.

The Legislature has enacted a law authorizing towns and counties to levy a tax, not exceeding ten per cent. in favor of any one road, on the amount of the last State assessment of property; and for all roads and all improvements to which aid is given, the tax shall not exceed twenty-five per cent. No bonds can be issued to any company for any road or section of road unti it is completed.

Louisville & Nashville.

This company, with the help of Louisville, seems determined to secure a line to the Gulf. The Board of Aldermen on the 22d inst. unanimously passed an ordinance subscribing $375,000 to aid this company in securing the lease of the Nashville & Decatur Railroad, extending from Nashville due south 120 miles to Decatur, Ala., and an interest in the North & South Alabama Railroad, which will soon have a complete line from Decatur southward to Montgomery, Ala., 183 miles, whence lines are in operation to Mobile and Pensacola. This would give a route 674 miles long from Louisville to Mobile, and 652 miles long from Louisville to Pensacola.

The ordinance making this subscription is to be submitted to a vote of the people of Louisville on the 9th of May.

New York & Oswego Midland.

The New York *Tribune* anticipates the growth of numerous manufacturing villages along the southern division of this road, which traverses a country abounding in water power and with considerable mineral resources.

Richmond, Fredericksburg & Potomac.

This company has bought the old "Ficklin charter," which gives it the right to construct a railroad from a point on its line at or near Fredericksburg up the Potomac to Alexandria.

Dan River & Coal Field.

A Virginia Company of this name has lately been organized to build a road from Danville, Va., southwest to Statesville, North Carolina, about 110 miles. A portion of this route, from Danville up the Dan River to Germanton, was surveyed and located in 1860, but nothing further was done at the time.

St. Joseph Bridge.

The drawings, specifications and estimates for the bridge were to have been submitted to the directors this week, by the Chief Engineer, Col. Mason. It is probable that bids will be asked for early in May.

ELECTIONS AND APPOINTMENTS.

—Mr. W. H. Pettibone has resigned his position as General Superintendent of the Davenport & St. Paul Railroad, and accepted the Assistant Superintendency of the Burlington, Cedar Rapids & Minnesota Railway. His headquarters will be at Cedar Rapids.

—Mr. S. B. Gault, for a long time Freight and Ticket Agent of the Chicago & Northwestern at Cedar Rapids, and more recently of Sterling, Ill., has been appointed General Freight and Ticket Agent of the Burlington, Cedar Rapids & Minnesota Railway. His headquarters will be at Cedar Rapids.

—John Newell, for some years Vice-President of the Illinois Central Railroad Company and previously Superintendent of the New York Central Railroad, has been chosen by the Directors President of the company in place of John M. Douglas, whose resignation was accepted about two months ago.

—A. Mitchell, since Mr. Hughitt's resignation two months ago Assistant General Superintendent and previously Superintendent of the Chicago Division of the Illinois Central Railroad, has been appointed General Superintendent.

—Major James A. Burns has been appointed General Superintendent of the new Brunswick & Albany Railroad (misprinted last week New Brunswick & Albany), and George L. Cook, General Freight and Passenger Agent of the same road. Their offices are at Brunswick, Ga.

—The following are the officers and directors of the Narrow-Gauge Railroad Company, chartered by the New Jersey Legislature last winter, and organized in Elizabeth, N. J., on the 15th inst.: William Bell, President; Alfred W. Jones, Vice-President; Hugh L. Cole, Treasurer, and George E. Brown, Secretary. The directors are William Bell, A. W. Jones, W. G. Thomas, and Courtlandt Parker, of New Jersey, and P. E. Wight, H. L. Cole and Nicholas Murray, of New York.

—A meeting of the stockholders of the Peoria, Atlanta & Decatur Railroad Company was held on the 20th inst., at Peoria, when the following directors were elected for the ensuing year: W. H. Cruger, J. T. Lindsay, J. Burwell, John Waugh, W. S. Dunham, R. G. Ingersoll and A. U. Dills. At a meeting of the above directors the following officers were elected: John T. Lindsay, President; Joe H. Stevison, Secretary; W. E. Stone, Treasurer.

—The Dan River & Coal Field Railroad Company was organized in Virginia lately by the election of the following directors: Colonel William Johnston, J. Turner Morehead, R. F. Simonton, S. A. Sharpe, A. B. Springs, A. C. Cowles, P. W. Hairston, P. M. Stone and W. T. Sutherlin.

A meeting of directors was called, when Colonel William Johnston was elected President of the company and J. Turner Morehead, Vice-President.

—At a meeting of the stockholders of the Shenandoah Valley Railroad, on the 18th inst., at Charlestown, Jefferson County, Virginia, the following persons were elected managers and officers for the ensuing year: Managers—J. M. Walker, B. K. Jamison, G. H. Bardwell, P. B. Borst, M. Spitler, J. M. Ashby, Wm. Milnes, A. R. Boteler, W. H. Traverse, A. W. McDonald; President, Thomas A. Scott; Vice-President, Wm. Painter; Treasurer, B. K. Jamison; Secretary, Thos. N. Ashby.

TRAFFIC AND EARNINGS.

—The traffic receipts of the Grand Trunk of Canada, for the week ending April 1, amounted to £31,400, against £29,500 in the corresponding week of last year, showing an increase of £1,900, or 6½ per cent.

—The earnings of the Union Pacific for the first three months of 1871 were $1,353,497.53, and the operating expenses $794,012.75; net earnings, $559,383.90. For the same quarter of 1870 the gross earnings were $1,567,906.73; expenses, $1,366,689.66; net earnings, $201,217.07. This shows a decrease in gross earnings of $214,409.20, a decrease of working expenses of $574,676.91, and an *increase* in net earnings of $358,166.83. The decrease in expenses is astonishing.

—A bill passed the lower house of the Ohio Legislature on the 24th inst. to prevent officers of railroad companies from becoming stock-holders in fast-freight lines.

Address of Henry Bessemer before the Iron and Steel Institute.

We make the following extracts from the very able inaugural address, delivered by Mr. Bessemer on entering upon his duties as President of the Iron and Steel Institute:

Among the most important improvements lately effected in the manufacture of steel is the development, by Sir Joseph Whitworth, of the system of casting under hydraulic pressure. The casting of large masses of steel, free from air bubbles, has long been a source of difficulty, owing chiefly to the fact that at the extremely nigh temperature of molten steel a certain quantity of oxygen is absorbed and retained by the metal so long as this high temperature is kept up, but which it cannot keep in combination when the metal is cooled down to the point at which it commences to solidify; hence, when the fluid metal is received in a cold mold, large volumes of gas are given off, some of which becomes entangled in the solidifying mass, and is there retained, forming numerous cells or honeycombs. A similar result is met with in finery iron, when it is "overblown;" carbonic oxide gas is liberated in abundance during the solidification of the plate metal, and gives rise to the peculiar cellular structure so well known. Another defect, inherent in steel castings, owes its origin to the crystalline structure assumed by the metal in the act of solidification. So long as the metal retains undisturbed the original crystals formed by casting, the mass is only feebly coherent—its tensile strength is less than half to which it rises when hammered or rolled. It will bend only a few degrees from the straight line without fracture, while its power of elongation is also extremely limited; but if considerable pressure be applied while the steel is passing from the fluid to the solid state, the crystals, which would otherwise become almost independent structures, are united or welded together so perfectly at this high temperature, and in their almost plastic state, as to develop the most perfect cohesion of all parts of the mass, probably more perfect than any subsequent operation of hammering could effect. In a patent, which I obtained in 1856, I described a method of casting steel under hydraulic pressure in iron molds—a cold wrought-iron plunger being forced into the semi-fluid steel at one end of the mold, through the agency of the hydraulic pressure applied to its opposite end. About the same period, I had observed, that in those cases where fluids gave off gaseous matters under ordinary atmospheric pressure, that they were prevented from doing so by increasing the pressure on their surfaces. A familiar example of this action is seen the instant we release the gaseous pressure, by the removal of the cork from a bottle of champagne; and it occurred to me, that if I subjected the fluid steel to additional atmospheric pressure, that the boiling of the metal in the mold would be prevented. Thus arose the first idea of casting under the pressure of air, or gases, pumped into a close chamber of great strength, in which the mold and casting were enclosed; but owing to numerous engagements, these inventions were left in abeyance until attention was again called to the subject, a few years since, by Sir Joseph Whitworth, who, finding great difficulty in making steel castings free from air bubbles, and of sufficient cohesive strength for the manufacture of his guns and projectiles, hit upon the idea of subjecting the metal, while still fluid, to the action of an hydraulic plunger, forced into the mold. His experiments, in connection with this system of casting, have been most successful. Indeed, I can bear witness to the extreme soundness of several large cylindrical masses, turned and bored, which were shown to me at his works, in neither of which the most minute flaw or bubble hole was visible. It was also stated that these simple castings under pressure were as strong, or even stronger, than bars of hammered steel. In justice to Sir Joseph Whitworth, I feel bound to say that I have no doubt whatever, but that he was wholly unaware of the existence of my previous invention, at the time he brought forward his system of casting under hydraulic pressure, by which the material now known as "Whitworth metal" is produced. Certain it is, that we owe to him the development, and first practical application of this system of casting steel under a pressure transmitted direct to the fluid, or semi-fluid metal, by a plunger actuated by hydraulic force.

It is difficult to estimate the importance of any process by which a malleable metal, stronger than forged iron, might be readily cast at once into the desired form; but it is just this question of form which still presents the difficulty. It will be readily understood that any plain parallel figure like an elongated shot, or a solid cylinder or ingot, may be compressed by a plunger at one end, and a tolerable uniform effect be produced throughout the mass of metal; but it is far different with more complex forms. For instance, let us apply the same force to one end of a loam mold, in which a double-throw locomotive crank is to be cast. In this case we should have two breaks in the continuity of the column pressed upon; and even if it were possible to prevent those parts of the mold between the throws from being crushed in by the enormous pressure transmitted to the end of the crank, we should infallibly fail from another cause. The plunger would, doubtless, transmit the pressure throughout the whole mass, so long as the metal remained fluid; but this is just the period at which pressure is of little or no use, as a substitute for forging; it is when solidification and a reduction of bulk is taking place, by cooling, that the force is most needed, to prevent the formation of cavities in the central parts of the mass, and to cause that cohesion of the crystals which, in other cases, is effected by the after process of hammering. It will also be obvious that the ram would be wholly incapable of transmitting force throughout the contorted limbs of a crank-axle while in the act of solidification. Hence, in this, and in hundreds of other required forms, the plunger system of transmitting pressure would prove an entire failure. There are also other insuperable difficulties in the way of this system of applying pressure to the general run of castings required in steel; the mold for each article would have to be made of enormous strength, and be only very thinly coated on the inside with clay or loam, to prevent the crushing of these materials and the consequent distortion of the casting, while the iron mold, having only a thin coating of yielding material, would oppose the natural contraction of the mass, which would tear itself to pieces. It, however, appears that all these difficulties may be at once overcome by simply using an ordinary mold box, and molding the article in the common way, a very strong hooped vessel being provided in which the molds may be placed. The opening by which the metal is run into this vessel may then be closed by a screw plug; an artificial atmosphere of considerable pressure may be gradually generated in the vessel by the combustion of a mixture of anthracite coal and nitrate of soda, ground to fine powder, and producing an incombustible gas having any desired amount of pressure, and acting on all directions on the casting, but with no more strain on the mold than it would be subjected to under ordinary atmospheric pressure. If, by this, or any other means that may be suggested, we could obtain steel or malleable iron castings, free from air bubbles and of great cohesive strength, an immense point would be gained. Those who have seen the beautiful castings in steel produced in Germany by the Bochum Steel Company, and also those of not less merit produced by Messrs. Vicars & Co., of Sheffield, will fully appreciate the importance of giving to such castings the perfect malleability and cohesive strength of steel forgings.

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The great development of the mechanical arts within the last century has rendered it extremely desirable that certain uniform standards of size, or measure, should be set up, by means of which an uniformity of practice has, in many cases, resulted. Thus, we owe to Sir Joseph Whitworth a series of standard gauges, which have been universally adopted in engineering establishments, to the great advantage of the manufacturer and the user of the machinery in which these accurate and definite sizes of parts have been introduced. The same may be said of the Whitworth screw threads so generally employed in our mechanical workshops. But perhaps the most marked application of the employment of standard screw threads is found of welded iron gas pipes, from which we derive an amount of advantage which, owing to our familiarity with it, is rarely appreciated to its full extent. So obviously advantageous is this system, that we happily see its principle extending from day to day, even to an entire mechanical structure, as in gun-making, where every part is made to a standard pattern, so that the possession of a few duplicate parts will enable a broken or otherwise useless rifle to be perfectly restored in a few minutes, at a cost immeasurably below that which would have been required to make a single part to order. And it must be borne in mind that this system of standard sizes not only affords great advantages to the general public, but it lessens the cost of production by admitting of the employment of special tools and appliances for the production of these numerous pieces, which could not be employed in the chaotic state reigning in our manufactories before these principles were applied. In the early days of our railway system the great Stephenson and his compeers had to feel their way gently in the new career they were pursuing; their engines were mere toys compared with those we now employ, and the loads they drew were small in proportion. It was, therefore, only necessary that they should employ a rail suitable to the traffic of the lines as then worked; but as the railway system began to develop itself, and new lines were opened, the necessity for heavier engines and greater traffic became apparent to the engineers by whom they were designed. Nor was the mere addition of size the only point studied; different modes of laying down the rail were proposed, and were canvassed with great interest. Stone blocks gave way to cross wood sleepers, and these again had their rivals in longitudinal sleepers, and with them came the bridge rail and the Vignoles rail, and the double-headed rail now commonly in use. Nothing could be more natural than the way in which the profession thus glided imperceptibly into the adoption of rails, of almost every imaginable variety of form and size, nor can any one be blamed for a result almost inevitable under the circumstances.

But it is now evident that there is no need in practice for this infinite variety of size and form; we know pretty accurately what is the general average traffic on a line, and the weight of our engines. The work which a rail has to perform is so perfectly simple, and so clearly defined, that there cannot at the present day be any difficulty in establishing a standard rail suitable for all purposes.

Thus, suppose we take the double-headed and the Vignoles rail as representing the two classes of rails suitable for longitudinal or cross sleepers, and if we make a heavy, medium, and light one, of each of these types of rail, we should have a choice of six sizes, that would supply all the reasonable demands of our present railway system. Taking these three standard sizes of iron rails, of each class, I would then make three other standards of steel rails, in which the table or wearing surface was identical in each case with the iron standard, but so reduced in weight per yard as to reduce its powers to resist a blow, or to sustain a weight precisely equal to the iron standard, so that in all cases the iron *a b c* rails, and the steel *a b c* should possess the same powers of resistance to a heavy load, or a sudden concussion. We should thus diminish the great apparent difference in price between the iron and steel rail, for it must be remembered *that the price per mile, and not the price per ton*, is the real test of the *cost of rails*. The adoption of a standard rail would afford great facilities to the manufacturer, by diminishing his stock of *rolls* and allowing him to manufacture in slack times, and to supply any sudden demands from stock. It would lessen the cost of production and afford the general advantages to the consumer and producer which have hitherto resulted in all cases from the adoption of universal or standard measures. It is difficult to imagine the state of utter confusion that would have reigned throughout our whole railway system had the gauge differed on every line to the same extent as the rails. The one instance afforded by the broad gauge is sufficient to convince us of the immense disadvantages that would have resulted from such an error, and I doubt not, but should we happily arrive at a universal *a b c* standard for rails, we should in the future look back with dismay on our present chaotic state.

I, therefore, feel a conviction that the time has arrived when a conference with our leading railway engineers would result in the adoption of an iron and steel *a b c* standard for rails, to the great advantage of all concerned. There would, of course, be no difficulty in supplying, if required, *outside sizes* at a *higher quotation*.

Steam on Canals.

On page 233 of our previous issue, we noticed the proposition—now before the New York Legislature—to offer a reward of $50,000 for a practical method of introducing steam on canals; the degree of practicability requisite to secure the award being determined by a board of commissioners, and the plan—should it stand the test of successful practice for one year—is to receive a further premium of the same amount. The several systems offered for competition must be tried during the present year, at the cost of the applicant. The conditions are specific: "The boat must be laden, when tried, with one hundred and fifty tons of cargo. It must move at the rate of at least three miles an hour; must be capable of being easily stopped or backed; the economy, simplicity and durability of the invention must be considered; it must be easily adapted to the boats now in use; the commissioners must be satisfied that the invention will cheapen transportation, and it must not hinder the movement of boats now navigating the canals."

As was to be expected, the amount of the proposed reward has stimulated attention to the subject, and caused many projects to be brought forward. But few of these possess any degree of novelty, most of them being revivals of plans that were produced in England many years ago when the subject of steam propulsion on canals excited even more interest than is now the case in this country. Of more than a dozen different schemes of the kind presented for our examintion within the past fortnight, only one showed sufficient novelty to justify us in recommending an application for a patent.

At this time, it may be well to enumerate the more noticeable of the various means suggested for securing the end above referred to, for some are very ingenious, and each and all have been reinvented at least a score of times. In 1843, Henry Pinkus, an American then residing in England, projected the propulsion of canal-boats by an engine carried on the boat, and which actuated a system of grippers clutching something after the manner of pawls upon rails laid on the banks. He proposed in some cases to substitute cog-wheels for the grippers. Something similar to this was the plan of John Lake, in which wheels at each side worked upon rails ranged upon piles at one or both sides of the canal throughout its entire length. He also designed to replace locks by inclined planes, up which the boats should pass upon rollers moved by the wheels gearing into fixed racks. Henry Pinkus had previously, in 1834, elaborated the idea of laying a tube on the tow-path, through which a magnetic piston was to be forced by atmospheric pressure, the piston being expected to draw the boat by its attraction for a mass of iron carried on the latter, a plan even more vissionary than the oft-suggested one of causing a propeller to act against the air instead of the water in order to avoid undue disturbance of the latter and consequent washing of the banks.

James Pilbrow, in 1848, designed a method of ranging a water-pipe on the path with valves automatically opened as the boat passed. Water under great pressure was forced into the pipe, and, escaping in forcible jets against resisting surfaces provided on the boat, was expected to drive the vessel along from valve to valve the whole length of the pipe.

There is another plan, quite different from any of those above mentioned, that has frequently been revived, and which seems at first sight to have some merit, viz.: the use of a wheel connected with and driven from the boat, and running upon the bottom of the water-course. It has, however, given no advantages on trial, and in point of novelty is behind the others, for it was invented by Martenat one hundred and sixty-nine years ago. About fourteen years since an English inventor proposed a screw working on the bottom for the same purpose. The use of a chain on the bottom, affording an anchored resistance to the pulling action of machinery on board the boat, has met with some degree of favor and has met with a good share of success in the navigation of rapids on the European rivers.

Another system, which consists essentially in pumping the water out at the stern so that its reaction shall propel the vessel, is now being taken up in several different forms, although the principle itself is at least three-fourths of a century old. In one modification, a tubular longitudinal channel is formed through the boat, and in this a propeller is arranged to drive the water through, while in another form paddle-wheels are provided at the sides, and externally to these is a casing, so applied as to prevent the lateral movement of the agitated water toward the banks of the canal.—*American Artisan.*

—The traffic receipts of the Great Western of Canada, for the week ending March 31, amounted to £20,619, against £17,747 in the corresponding week of last year, showing an increase of £2,872, or 16⅛ per cent.

Narrow Gauge Locomotives.

The circular of Mr. Baird & Co., proprietors of the Baldwin Locomotive Works, from which we extracted the estimates of cost of narrow-gauge superstructures in the RAILROAD GAZETTE of April 15, gives the following specifications of 6 classes of locomotives which this firm is prepared to build:

The designs shown can all be arranged for a gauge of 2 feet 6 inches, or upwards. For a gauge narrower than 2 feet 6 inches, special patterns or modifications of these plans would be required.

The following table gives the principal dimensions and weights of various patterns and sizes of narrow-gauge locomotives, together with the loads which they will haul on a straight track in good condition:

KIND OF LOCOMOTIVE.	CYLINDERS. Diam.	CYLINDERS. Stroke.	DIAMETER OF DRIVERS.	WEIGHT IN WORKING ORDER. Total.	On drivers.	On each pair of drivers.	LOAD IN GROSS TONS OF CARS AND LADING. On a level	On a 40 feet grade.	On an 8 feet grade.	On a 100 feet grade.
CLASS 1. Four-wheels-connected tank locomotive	9	12	30	16,000	16,000	8,000	300	120	70	55
	9	16	35	20,000	20,000	10,000	400	150	85	70
	10	16	36 to 40	24,000	24,000	12,000	500	170	105	85
CLASS 2. Four-wheels-connected with separate tender	9	12	30	16,000	16,000	8,000	325	115	65	50
	9	16	35	20,000	20,000	10,000	450	140	75	60
	10	16	36 to 40	24,000	24,000	12,000	550	170	95	75
CLASS 3. Six-wheels-connected tank locomotive	10	15	36	28,000	28,000	9,333	615	185	105	80
	11	16	38	33,000	33,000	11,000	740	225	125	100
	12	16	36 to 40	38,000	38,000	12,666	850	265	150	125
CLASS 4. Six-wheels-connected with seperate tender	10	16	36	25,000	25,000	8,333	605	175	95	73
	11	16	38	30,000	30,000	10,000	730	215	120	90
	12	16	36 to 40	35,000	35,000	11,666	850	255	140	115
CLASS 5. Four-wheels-connected and one pair of leading wheels	9	16	36	20,000	20,000	10,000	480	140	75	60
	10	16	36 to 40	25,000	25,000	12,500	605	175	95	75
CLASS 6. Six-wheels-connected and one pair of leading wheels	10	16	36	30,000	25,000	8,333	605	175	95	75
	11	16	36 to 40	35,000	30,000	10,000	730	210	120	100

The last two patterns can be built with tanks on the boilers to carry the feed water, and the boxes for coal or wood on the foot-board, if it is desired to dispense with the separate tender. For runs of any considerable length, however, it is believed that the engine would be more satisfactory with separate tender, and the weight of such tender will be so small as to detract very little from the tractive efficiency of the machine.

SERVICE TO WHICH THE SEVERAL PATTERNS ARE ADAPTED.

Classes 1 and 2 would be suitable for hauling freight at low speeds. For a short run the tank engine (class 1) would answer; for a longer run, requiring more fuel and water to be carried, a tender would be necessary, and class 2 would be preferable.

All four-wheeled engines, however, when run at any considerable speed, have a backward and forward rocking or plunging motion on the rails, which is objectionable as injurious both to track and engine. The other classes (3, 4, 5 and 6) show designs which obviate this objection, and allow of higher speeds.

Classes 3 and 4, by coupling three pairs of drivers, give machines which, while they have no more weight on each wheel than the four-wheeled engines of classes 1 and 2, have, nevertheless, fully 50 per cent. more tractive power. These two classes are adapted to an exclusively freight business.

In Class 5, in order to prevent the rocking motion peculiar to four-wheeled engines, as stated above, a single pair of leading wheels is introduced in front of the cylinders. These wheels serve to guide and steady the engine, and prevent the excessive wear of the tires of the front driving-wheels which would otherwise result. As they carry only a small portion of the weight of the machine, they do not materially detract from the weight available for adhesion.

It will be apparent that engines of this class are especially suited for passenger business. They can be run at high rates of speed, as will be shown in a subsequent paragraph, and, it is believed, will occupy the same relative position in the narrow-gauge system which the ordinary eight-wheeled locomotive with four drivers and truck fills to-day on the full-gauge railway.

Class 6 shows an extension of the same principles in a six-coupled engine for freight service.

ADAPTATION FOR PASSING SHORT CURVES.

All these machines are designed on such principles as will enable them to pass curves of short radius with ease. The engines of classes 5 and 6 have a single pair of leading wheels with swinging bolster and radius bar. By this device these wheels adapt themselves readily to a curve, and the rigid wheel-base of the engines is reduced to the distance between centers of rear and front drivers. Any of the engines described may be run around curves of 100 feet radius or even shorter. Engines of classes 1 and 2 have been run around curves of 30 feet radius.

CHARACTER OF ROADS WORKED BY OUR SMALL LOCOMOTIVES.

We have built a number of engines of classes 1 and 2 for use on roads of 2 feet 6 inches, 2 feet 9 inches, 3 feet, and 3 feet 6 inches gauge, respectively, and are now building locomotives of the last two classes (5 and 6) as the equipment of an important 3-feet gauge line (the Denver & Rio Grande) which will be in operation for a part of its length during the present season.

The Union Valenciana Railroad of South America, is worked by engines of our manufacture, of the kind designated by class 2, with 9x16 cylinders. The road is 15 miles long; 3 feet 6 inches gauge; has a maximum grade of 169 feet to the mile, and a maximum radius of curvature of 235 feet. It is laid with T rail weighing 40 pounds to the yard.

Several narrow-gauge roads connected with iron furnaces or mining enterprises in this and adjacent States are worked with small engines of classes 1 and 2 These roads, on which are in use engines weighing from 18,000 to 20,000 pounds (being 9,000 to 10,000 pounds on each pair of wheels), are laid with rails weighing from 30 to 40 pounds to the yard. Those using the 30-pound rail consider it heavy enough. The joints are made with chairs or fish plates. The chairs cost about 20 cents each. Fish plates 13 inches long with four bolts and nuts for a 30-pound rail can be made for about 45 cents per joint. The spikes are one-half inch square, 5½ inches long, and weigh 40 pounds to the hundred. The cross ties are about 5 feet long for a 2½-feet gauge, and 5 to 6 inches face and depth, and are laid from 2 feet to 2 feet 6 inches from center to center.

SPEED ATTAINABLE WITH SMALL LOCOMOTIVES.

A narrow-gauge locomotive with driving-wheels 36 inches in diameter and cylindery with 16 inches stroke, at a speed of 36 miles per hour, develops the same speed of piston as a full-gauge locomotive with 5 feet driving-wheels, and cylinders with 24 inches stroke, at a speed 40 miles per hour. With driving wheels 40 inches in diameter and 16 inches stroke of piston, the narrow-gauge locomotive develops the same total travel of piston in going one mile as does the full-gauge locomotive with driving wheels 60 inches in diameter and 24 inches stroke of piston. It is evident therefore, that equal speeds are attainable on the narrow as on the full gauge. The angle of stability of the narrow-gauge locomotive with 3 feet driving-wheel is somewhat greater than that of the 4 feet 8½ inch gauge locomotive with 5 feet driving-wheel.

A UNIFORM NARROW-GAUGE SYSTEM DESIRABLE.

For narrow-gauge lines of any considerable length and intended for both freight and passenger traffic, a gauge of 3 feet seems to have been generally agreed upon. If a system of narrow-gauge roads is to be constructed in this country (and such now seems to be the tendency), it is manifestly important that a uniformity of gauge should be established. The 3-feet gauge has the decided preference of practical railroad managers and engineers who have given the subject attention, and as this width has very important advantages in the designing of locomotives and other rolling stock, it is believed that its general adoption for the narrow-gauge system would be advantageous. We may mention that the Denver & Rio Grande Railway, now in process of construction for 80 miles of its projected length is to be of 3-feet gauge; and the Pennsylvania & Sodus Bay Railroad, another narrow-gauge line 83 miles in length, has also adopted this gauge after careful investigation.

COMPARATIVE WEIGHTS OF NARROW AND FULL-GAUGE CARS.

We subjoin as pertinent to this subject, the following table showing the comparative proportions of dead weight to paying load of full-gauge and narrow-gauge cars:

	Capacity.	Weight of Car Empty.	Weight of Car Loaded.	Weight of Wheels and Axles.	Weight on all the Wheels.	Weight on each Wheel.	Per centage of Dead Weight to Load.
	pounds.	pounds.	pounds.	pounds.	pounds.	pounds.	
Full-gauge eight-wheeled box car	20,000	20,000	40,000	5,400	34,600	4,325	100
Narrow-gauge four-wheeled box car	8,000	4,500	12,500	1,500	11,000	2,925	56 1-4
Full-gauge eight-wheeled flat car	24,000	16,000	40,000	5,400	34,600	4,325	66 2-3
Narrow-gauge four-wheeled flat car	9,000	3,500	12,500	1,500	11,000	2,925	38 8-9
Full-gauge four-wheeled coal car	11,000	6,000	17,000	2,300	15,300	3,825	60
Narrow-gauge four-wheeled coal car	8,500	4,000	12,500	1,500	11,000	2,925	47

DESIGNS FOR NARROW-GAUGE CARS.

Designs for narrow-gauge freight cars by prominent manufacturers show four-wheeled box, flat, and drop-bottom coal or ore cars. Their weights and capacity are indicated in above table.

For passenger service, eight-wheeled cars with bodies 26 feet long and 6 feet wide, are proposed, as follows:

Second-class cars with longitudinal slatted seats in centre (passengers to sit back to back). Capacity 26 passengers.

First-class passenger cars with seats and cushions like horse railway cars. Capacity 30 passengers.

First-class passenger cars with two rows of turning chairs with aisle between, etc. Capacity 18 passengers.

First-class passenger cars with revolving back seats (double seat on one side of car and single seat on the other, the plan being reversed in the two ends of the car). Capacity 28 passengers.

All these cars to have wheels about 24 inches in diameter.

The Canada Canals.

From an official report just issued we have compiled a tabulated statement, published elsewhere, which exhibits, in a brief but comprehensive form, the length and character of our present canals. The remarkable inequality in the dimensions of the locks, and in the depth of water on the sills, show a deplorable want of uniformity, and of a well devised plan with reference to these important works.

From this table the total length of the canals, the rise of lockage and the number of locks may be deduced, as follows:

	Miles in length.	Rise of lockage, feet.....	No. of locks...
St. Lawrence canals	70⅞	536½	54
Welland and branches	50¾	163½	32
Rideau system	134⅝	358½	45
Richelieu & Lake Champlain	12½	79	10
St. Peter's, Cape Breton	½	9	1
Burlington Bay	½	....	..
Total	269½	1,146½	142

The objects aimed at in these important public works we propose to state in the briefest manner possible.

In the St. Lawrence navigation the canals are for the object of enabling vessels to pass the rapids on that river. The Lachine avoids the St. Louis Rapids at Lachine; the Beauharnois carries navigation round the Cascades, the Cedars and Coteau du Lac rapids; the Cornwall avoids the Long Sault Rapids; the Farran's Point avoids the Farran's Point Rapids; the Rapide Flat overcomes the rapids of that name; the Galops avoids the Iroquois, the Cardinal and the Galops rapids. The Welland passes from Lake Erie to Lake Ontario and avoids the Falls of Niagara and the rapids above and below the cataract. The Burlington Bay Canal is a cut through a sandbar at Hamilton, which enables vessels to pass from Lake Ontario into Burlington Bay. The system of navigation between Montreal and Kingston passing round by Ottawa includes the Carillon, Chute a Blonde, the Grenville, the Rideau and the St. Anne canals, the first four of which were designed as military works; the Carillon carries navigation round the Carillon Rapids on the Ottawa River; the Chute a Blonde avoids rapids of that name on the same stream, the Grenville overcomes the Long Sault Rapids, the Rideau connects the Ottawa River with the lower end of Lake Ontario and extends from Ottawa city to Kingston; it is simply a series of works converting the Rideau and Cataraqui rivers into a continuous navigable channel. The Richelieu & Lake Champlain navigation extends from Sorrel, at the mouth of the Richelieu River, a point 46 miles below Montreal, to Lake Champlain in the State of New York. The Canadian canals on that route are the St. Ours and the Chambly; on the American side are the Champlain and a portion of the Erie.

The reports (of the majority and the minority) of the Canal Commissioners are expected to reach the public before long, when we hope a comprehensive and intelligent scheme for more fully utilizing the existing canals will be brought forward, as well as valuable suggestions with reference to the new projects before the country. About twenty millions of dollars have been expended on canals in Canada; but that expenditure has never benefited us as it should have done, from the want of a uniform system. We shall look with interest for the forthcoming report.—*Canadian Monetary Times.*

—In the case of the United States against the Baltimore & Ohio Railroad Company, to recover $30,000 tax on interest of bonds the city of Baltimore issued to the company on account of a loan, Judge Giles decided that the government could not tax the bonds in question, as they were issued by the municipality, a part of the sovereignty of the State.

PUBLISHER'S ANNOUNCEMENTS.

New Book on Tracklaying.

The publisher of the RAILROAD GAZETTE will soon issue, in a small and convenient volume, the papers on track-laying, repairs and maintenance of road-bed and track, contributed last spring and summer to the RAILROAD GAZETTE by Mr. William S. Huntington. These papers have received almost universal commendation from railroad men, and it is believed that they give information of the highest value to roadmasters and section-men. The volume will be entitled "The Road-master's Assistant and Section-master's Guide." It will be published probably before the 1st of June. The price will be one dollar per copy. Orders may be addressed to this office.